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# The Ecological and Economic Impact of Water Resources Development in Southern Alberta: The Case of Fish and Wildlife

by James H. Snipe

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THE ECOLOGICAL AND ECONOMIC IMPACT OF WATER RESOURCES

DEVELOPMENT IN SOUTHERN ALBERTA:

THE CASE OF FISH AND WILDLIFE



by

James H. Snipe



department of the  
**environment**

GOVERNMENT OF CANADA

December 1970

Fish and Wildlife Division

↳ Department of Lands and Forests

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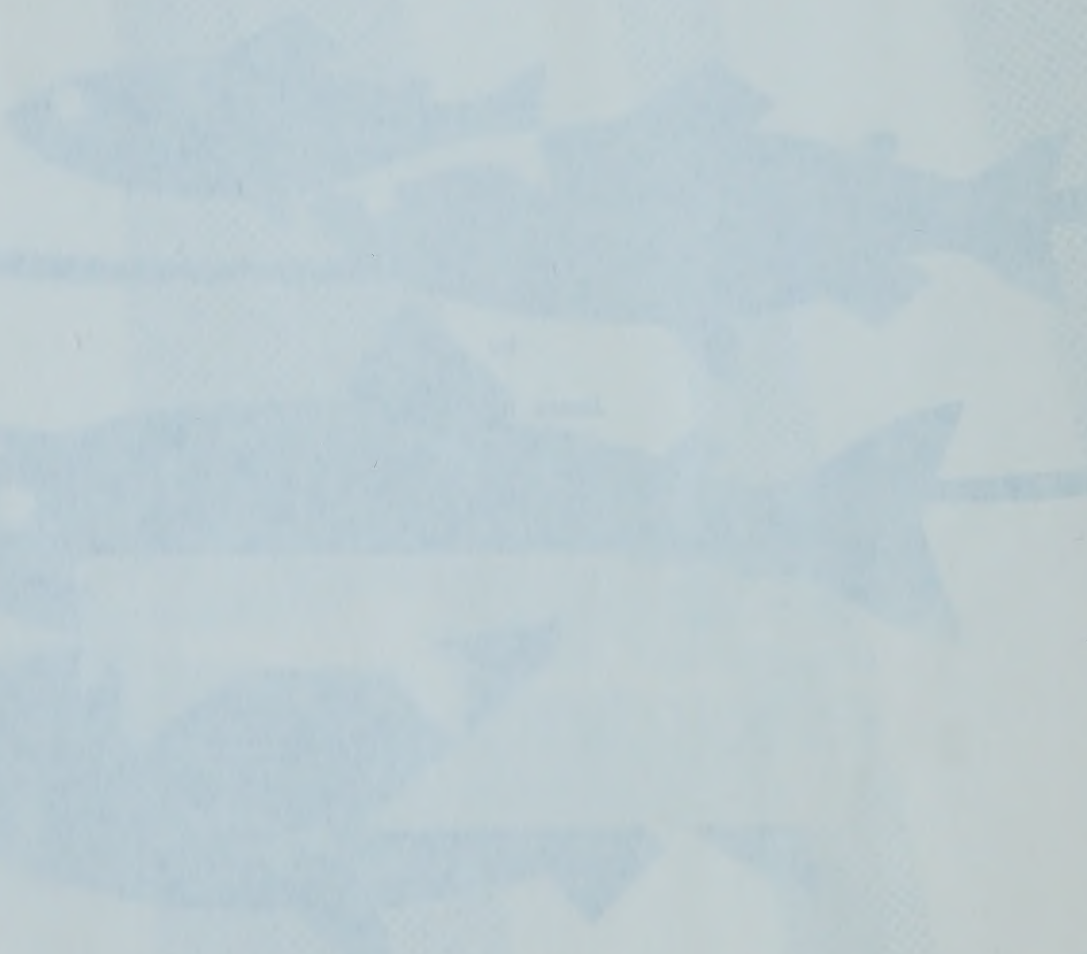
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THE ECOLOGICAL AND ECONOMIC IMPACT OF FISH

RESEARCH IN THE STATE OF ALABAMA

THE CASE OF FISH AND WILDLIFE



December 1978

Fish and Wildlife Division

NOTE:

This report is a reprint of the thesis submitted by James Snipe to the Department of Agricultural Economics and Rural Sociology, University of Alberta, as part of the requirements for a Master of Science degree. Mr. Snipe received partial financial support in the project from the Fish and Wildlife Division, Department of Lands and Forests.

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## ABSTRACT

If undertaken, proposed water resource development projects may have an extensive effect on the natural resources of Southern Alberta. This study attempts to determine the ecological and economic impact of the proposed developments on the South Saskatchewan and Milk River Basins in Southern Alberta.

Investigation into suggested water resource developments indicates that, if carried out, they would certainly affect fish and wildlife populations. An economic evaluation of Southern Alberta's fish and wildlife resources revealed that these resources are of considerable value both to the Province of Alberta and to recreationists. Thus, a change in fish and wildlife populations may result in a change in net social benefits. However, no change in benefits will occur if the net social benefits from any increase in fish and/or wildlife populations exactly offset the net social loss from any decrease in fish and/or wildlife populations.

Four important policy implications stem from this research. First, in view of the valuable benefits received from the region's fish and wildlife resources each year, policy makers and resource planners should give serious consideration to the needs of fish and wildlife before undertaking further resource development in Southern Alberta. Second, fish and wildlife biologists must participate in the planning, construction, and management stages of each project. Third, the large excess of benefits received from hunting and fishing activity in Southern Alberta over the cost of providing the same may justify greater expenditures on fish and wildlife. Finally, it may be necessary to compensate private landowners with monetary incentives to insure further the availability of Southern Alberta's fish and wildlife resources.



## ACKNOWLEDGEMENTS

The author appreciates the cooperation received from the following agencies: Canada Department of Energy, Mines, and Resources; Canadian Wildlife Service; Ducks Unlimited; Water Resources Division of the Alberta Department of Agriculture; and the Fish and Wildlife Division of the Alberta Department of Lands and Forests. The Department of Energy, Mines, and Resources provided the grant for this study. The Fish and Wildlife Division was especially helpful in providing the necessary funds and personnel for sampling recreationists.

A great deal of thanks is owed the thousands of hunters and fishermen who, through their cooperation in responding to questionnaires, provided vital information. I am hopeful that the much appreciated guidance and encouragement provided by my advisor, Dr. W. E. Phillips, helped me to complete a study which will repay the above recreationists with better hunting and fishing opportunities in the future.

I would like to express gratitude for the technical assistance provided by Kay Hohn and Bill Uganecz. In addition, the efforts of Darlene Friesen in typing this manuscript are appreciated.

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## CHAPTER I

### INTRODUCTION

Intensive development of Southern Alberta's agricultural and other industrial sectors has resulted in an increased demand for natural resources available in the area. Population increases have accompanied this development. These factors have tended to reduce the quantity and quality of natural resources for rural outdoor recreation activities. At the same time, participation in these recreational activities has increased. Consequently, there is an increasing need to evaluate resource use so that public policy implementation can be directed towards optimal use of these resources.<sup>1</sup>

Recreation needs must be considered when further developments of the river basins in Southern Alberta are being planned. Although many types of outdoor recreation, such as boating, hiking, picnicking, camping, skiing, hunting, fishing, and sightseeing, are enjoyed in the region, it is important to evaluate first those types of outdoor recreation that are most susceptible to gains or losses from further development of the area's river basins. Because of irreversibilities, fish and wildlife resources are the most widely affected. Irreversibilities are created when water resource development projects eliminate habitat for fish and/or wildlife which is not economically feasible to restore.

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<sup>1</sup>Optimal resource use refers to a situation in which a reallocation of resources and changes in resource development and management facilitate the maximization of the present value of social net benefits.



The need to evaluate fish and wildlife in monetary terms becomes more important as competition increases for the land and water resource base on which fish and wildlife depend. Procedures have been developed to evaluate most uses of the area's natural resources. It is difficult, however, to place a value on such non-priced resources as fish and wildlife. Nevertheless, an economic evaluation of these resources is essential before fish and wildlife can be compared with competing or alternate uses of the same resource base.

In addition to evaluating fish and wildlife resources, this study examines projected water resource development in Southern Alberta in relation to fish and wildlife. Through habitat modification, proposed water resource development projects could number among the most important factors affecting the future of fish and wildlife in Southern Alberta.

A program known as Prairie Rivers Improvement, Management and Evaluation (PRIME) has been conceived to guide the development of Alberta's water resources.<sup>1</sup> This program outlines a scheme to develop and utilize first the water in the rivers of Southern Alberta. As these rivers become fully utilized, water will be diverted from northern rivers to supplement rivers in the south. This study examines the economic value of Southern Alberta's fish and wildlife resources and the ecological impact of the PRIME scheme in order to determine the economic significance of PRIME in relation to fish and wildlife.

### Objectives of Study

This study seeks to determine the significance of proposed water resource developments in relation to Southern Alberta's fish and wildlife

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<sup>1</sup> Alberta Department of Agriculture, Water Resources Division, Development Planning Branch, Alberta's Blueprint for Water Development (Edmonton: ADA, 1969).



resources. The objectives are (1) to describe the study region and its fish and wildlife resources, (2) to identify and analyze the ecological impact of alternative water resource development plans on fish and wildlife, (3) to determine the economic value of fish and wildlife, and (4) to use the above information to draw conclusions and implications regarding the direction of future water resource development.

### Plan of Study

The plan of this study arises directly from its objectives. The initial chapter has introduced the nature of the study. The second chapter describes the study region and its fish and wildlife resources. Attention is given to fish and wildlife that are pursued by recreationists who hunt and/or fish in the region. Chapter Three identifies and analyzes the ecological impact of alternative water resource development proposals on the region's sport fish and wildlife resources.

The fourth chapter evaluates the fish and wildlife resources of the region. Several techniques are used within a benefit-cost framework to examine economic values arising from sport hunting and fishing activities in Southern Alberta. The fifth and concluding chapter discusses the economic costs and benefits of alternative water resources development proposals in terms of public policy alternatives and implications.



## CHAPTER II

### THE REGION AND ITS FISH AND

### WILDLIFE RESOURCES

#### The Region

Since the water resources in the South Saskatchewan and Milk River Basins will be the first to be extensively developed in Alberta, these river basins were the primary criterion for choosing the study area.<sup>1</sup> Delineation of regional boundaries was modified by using available political boundaries so that municipal districts, improvement districts, counties, and provincial boundaries remain intact. The value of this study was enhanced by deliberately choosing boundaries to coincide with those used by other studies currently under way in the region.<sup>2</sup>

#### Location and Description

The region covers approximately 37,500 square miles in the southern part of the Province of Alberta (Figure 1, Table 1). Extending over most of the region, prairies vary in elevation from 2,181 feet at Medicine Hat to 3,742 feet at Calgary (Figure 2). The Rocky Mountains form the western border of the region, ranging in height from the 8,643 foot Loaf

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<sup>1</sup> Alberta Department of Agriculture, Water Resources Division, Development Planning Branch, op. cit.

<sup>2</sup> The Economics Division of the Alberta Department of Agriculture and the Department of Agricultural Economics and Rural Sociology of the University of Alberta have joint responsibility for a major economic study being undertaken in the region. In addition to cooperation on the above study, the Water Resources Division of the Alberta Department of Agriculture is undertaking extensive studies in the region.



Figure 1

SOUTHERN ALBERTA STUDY REGION

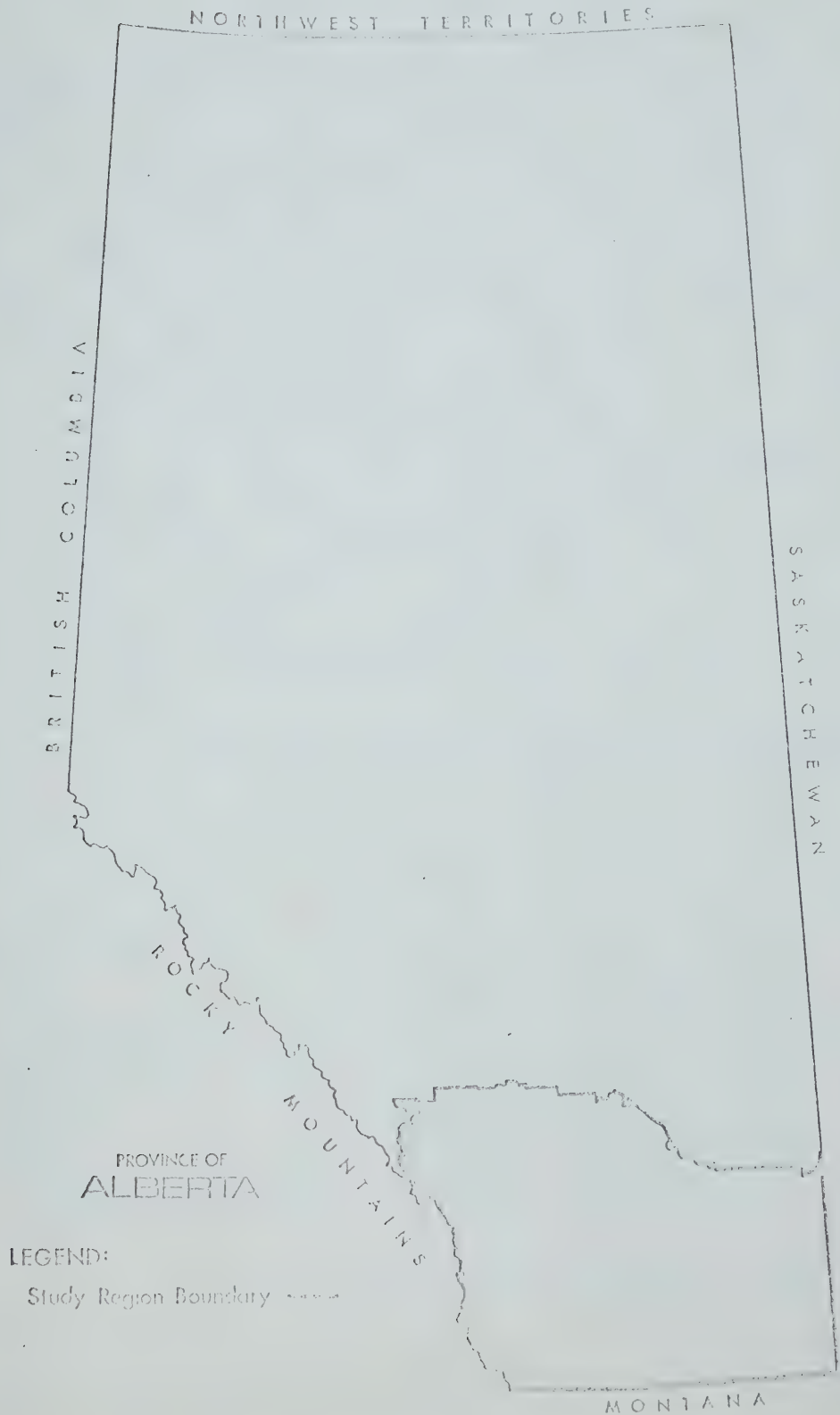
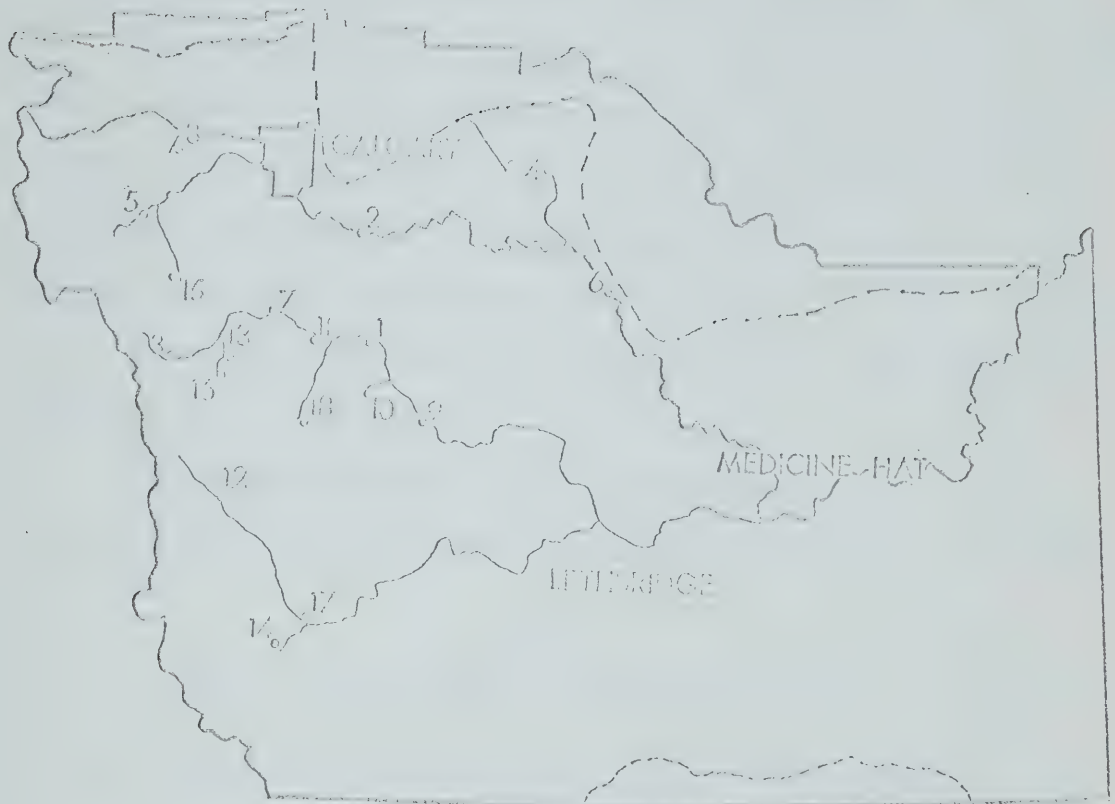




Figure 2

SOUTH SASKATCHEWAN RIVER BASIN  
DEVELOPMENT SITES



Legend<sup>a</sup>

| <u>Reservoir Site</u>          | <u>Location</u> | <u>Reservoir Site</u> | <u>Location</u> |
|--------------------------------|-----------------|-----------------------|-----------------|
| 1. Azure                       | 17-27-4th       | 10. Mosquito #1       | 15-27-4th       |
| 2. Bow-Highwood                | 21-27-4th       | 11. Mosquito #2       | 17-29-4th       |
| 3. Cataract                    | 16-5-5th        | 12. Oldman Gap        | 11-3-5th        |
| 4. Crowfoot Creek              | 23-20-4th       | 13. Pekisko Creek     | 16-3-5th        |
| 5. Elbow                       | 21-6-5th        | 14. Pincher Creek     | 6-1-5th         |
| 6. Eyremore                    | 19-18-4th       | 15. Sheep River       | 19-5-5th        |
| 7. Highwood-Longview           | 18-1-5th        | 16. Sheppard Creek    | 16-3-5th        |
| 8. Jumpingpound #1, #2, #3, #4 | 24-5-5th        | 17. Three Rivers      | 7-29-4th        |
| 9. Little Bow River            | 14-25-4th       | 18. Willow Creek      | 14-29-4th       |

<sup>a</sup>The shaded regions represent areas outside the South Saskatchewan River Basin (i.e. the Red Deer River Basin to the north and the Milk River Basin in the south).

Source: Water Resources Division, Alberta Department of Agriculture.



Mountain in the south to the 11,174 foot Mt. Sir Douglas in the north. The Cypress Hills are the only notable hills in the eastern portion of the region, rising to an average elevation of 1,500 feet above the prairies and located approximately 50 miles southeast of Medicine Hat.

The South Saskatchewan River is the largest river in Southern Alberta. With the exception of the Milk River in the extreme southern portion of the region, all the major rivers in the region flow into the South Saskatchewan River and eventually drain into the Hudson Bay. The Milk River is drained by the Missouri River System into the Gulf of Mexico. Most of the waters of Southern Alberta originate in the Rocky Mountains and contiguous foothills.

The climate of the region is influenced primarily by altitude, latitude, direction of the prevailing winds, and distance from the Pacific

Table 1

LAND USE IN THE SOUTHERN ALBERTA STUDY REGION

| Item                  | Land and Water<br>(square miles) | Percent of<br>Total Area |
|-----------------------|----------------------------------|--------------------------|
| Cities                | 193.36                           | .52                      |
| Towns                 | 37.54                            | .10                      |
| Villages              | 13.98                            | .04                      |
| Improvement Districts | 9,582.72                         | 25.56                    |
| Municipal Districts   | 8,930.66                         | 23.82                    |
| Counties              | 17,453.27                        | 46.56                    |
| Indian Reserves       | 1,273.00                         | 3.40                     |
| TOTAL                 | 37,484.73                        | 100.00                   |

Source: Department of Municipal Affairs, Province of Alberta, Annual Report, 1967 (Edmonton: Queen's Printer, 1969.)



Ocean. Climatic conditions vary from subarctic in the Rocky Mountains to semiarid prairie in the eastern portion of the region. Cold air masses from the Arctic often flow through the area during the winter months. At the other extreme a chinook effect is created when warm air masses flow down from the Rocky Mountains and cause rapid temperature increases.

Mean annual precipitation in the region varies from 26 inches in the Rockies to 12 inches in the southeast corner of Alberta. Almost half of the precipitation occurs during the summer months.

### Land Use Patterns

Most of the region's population (546,089) reside in the cities of Calgary (330,575), Lethbridge (37,186), and Medicine Hat (25,574) (Table 2). The remainder of the population is dispersed throughout towns, villages, Indian reserves, and other areas.

Table 2

#### POPULATION DISPERSION IN THE SOUTHERN ALBERTA STUDY REGION

| Item                  | Population<br>(1966 census) | Percent of Total<br>Population |
|-----------------------|-----------------------------|--------------------------------|
| Cities                | 393,335                     | 72.03                          |
| Towns                 | 46,008                      | 8.43                           |
| Villages              | 10,391                      | 1.90                           |
| Improvement Districts | 8,651                       | 1.58                           |
| Municipal Districts   | 51,817                      | 9.49                           |
| Counties              | 28,224                      | 5.17                           |
| Indian Reserves       | 7,663                       | 1.40                           |
| TOTAL                 | 546,089                     | 100.00                         |

Source: Department of Municipal Affairs, *op. cit.*



The region's six Indian reserves cover 1,273 square miles. The Stony, Sarcee, and Blackfoot Reserves are located within a 25 mile radius of Calgary. Another reserve, the Eden Valley, is situated about 25 miles west of Nanton. Two additional reserves, the Peigan and the Blood, are located between Lethbridge and Pincher Creek.

There are numerous parks in the region. Waterton National Park, located in the southwest corner, is the largest, covering approximately 200 square miles. Cypress Hills Provincial Park extends over an area close to 80 square miles along the eastern border of the region. Thirteen other provincial parks are scattered throughout Southern Alberta. Banff National Park borders the region's northwest corner.

Two forests, the Crowsnest and the Bow River, cover most of the forested area in the region. The former extends from Waterton National Park northwest along the Rocky Mountains and covers 1,354 square miles. The latter extends north of the Crowsnest Forest and covers 3,293 square miles, approximately two thirds of which is in the region.

An army experimental range extending over 1,000 square miles is located in the northeast corner of the region. The remainder of the region includes Crown land outside the forests, municipal land, and privately owned land used primarily for farming and ranching.

The largest share of the agricultural land in the region is devoted to cattle ranching and wheat growing on a specialty basis. Although cattle appear throughout the region, the largest numbers are located in the Calgary area. Most of the region's dairy products also come from this area. The irrigated areas of Southern Alberta have ample soil of suitable texture for growing vegetable crops. A longer growing season, higher summer temperatures, and irrigation make possible the



production of many crops that cannot be grown in other regions of Alberta.

"Horticultural practice under glass is most extensively developed at Medicine Hat. Flowers, cucumbers and tomatoes are the main crops."<sup>1</sup>

### Fish and Wildlife Resources

The region has many species of big game, upland game birds, waterfowl, and fish. These resources provide outdoor recreation for thousands of hunters and fishermen.

#### Waterfowl<sup>2</sup>

Geese---The western Canada goose is the only goose that nests in Southern Alberta. The Taverner's Canada goose, lesser snow goose, white-fronted goose, and Ross' goose migrate through the region.<sup>3</sup>

Ducks---The most common nesting species on the prairies of Southern Alberta are the pintail and the mallard, comprising about half the total nesting population. The blue-winged teal and shoveler are next in abundance. The baldpate, gadwall, and lesser scaup, although less numerous, are still common as nesting species. The green-winged teal and white-winged scoter occur, but are more common further north. Also occurring in small numbers as nesters are the canvasback, redhead, ruddy, and Barrow's goldeneye.<sup>4</sup> The black duck, wood duck, and cinnamon teal are occasional visitors to the region. The buffle-head, oldsquaw, harlequin

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<sup>1</sup>Alberta Bureau of Statistics, Alberta Industry and Resources (Edmonton: Queen's Printer, 1968), p. 80.

<sup>2</sup>See Appendix I, Table I, for relative abundance of ducks and geese in Southern Alberta.

<sup>3</sup>For further information on geese see: Joseph P. Linduska (ed.), Waterfowl Tomorrow (Washington, D. C.: Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, United States Department of the Interior, 1960).

<sup>4</sup>Fred Sharpe and Charles H. Lacey, Provincial Manager and Provincial Biologist, respectively, Ducks Unlimited, Personal Letter, Edmonton, Alberta, January 31, 1968. (Mimeographed.)



duck, surf-scooter, ring necked duck, and common goldeneye migrate through the region.<sup>1</sup>

### Upland Game Birds<sup>2</sup>

Native---The blue grouse, spruce grouse, ruffed grouse, and white-tailed ptarmigan all occur in the Rocky Mountains and the foothills of southwestern Alberta. Spruce grouse are fairly common in coniferous forest areas. Blue grouse are scarce to fairly common in the subalpine coniferous forests. Ruffed grouse are fairly common in the wooded park-land areas of the foothills. White-tailed ptarmigan are fairly common in the high mountain areas.

Only the sharp-tailed grouse and sage grouse are found on the prairies. Sharp-tailed grouse may be found throughout the prairies of Southern Alberta, but are most common in areas that are not extensively cultivated. Sage grouse are common only in the extreme southeastern corner of the region where sagebrush is abundant. The pinnated grouse, or true "prairie chicken," was once common on the prairies, but is now extinct in Alberta.

Introduced---The Hungarian partridge and the ring-necked pheasant have been successfully introduced into Southern Alberta. Although found in most of the prairie region, the ring-necked pheasant is most common in irrigated areas. Hungarian partridge are common throughout the prairie region.

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<sup>1</sup>For further information on ducks see: Francis H. Kortwright, The Ducks, Geese and Swans of North America (Harrisburg: The Stockpole Company, 1942).

<sup>2</sup>For further information on upland game birds see: Department of Lands and Forests, Upland Game Birds of Alberta (Edmonton: Queen's Printer, 1969).



## Big Game<sup>1</sup>

Cloven-hoofed--A variety of big game species are found in Southern Alberta. Moose and wapiti (elk) are common throughout the forested regions of the Rocky Mountains and the foothills. Both species also occur in the Cypress Hills in small numbers. Rocky Mountain bighorn sheep are fairly common in the Rocky Mountains and the adjacent foothills of southwestern Alberta. The Rocky Mountain goat shares the same range as the sheep, but is relatively scarce. Pronghorn antelope are common in the short and the mixed grass regions of Southern Alberta. Mule deer and white-tailed deer are common throughout most of the region. Only mule deer, however, live in the higher mountain areas.

Carnivorous--Black bear are fairly common in the forested and mountain areas of Southern Alberta, but the grizzly bear is a scarce resident in the same areas. Cougar are fairly common in the mountains and foothills of southwestern Alberta. Wolves may be found in the same areas as the carnivorous big game animals already mentioned, but are few in number. Coyotes are common in most areas of the region except the high mountains.

## Fish<sup>2</sup>

Native--The northern pike is common in the warm water lakes, reservoirs, and streams throughout Southern Alberta. Cutthroat trout and Rocky Mountain whitefish are common in the headwater streams in the Rocky Mountains and foothills. The dolly varden char is fairly common

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<sup>1</sup>For further information on big game see: Department of Lands and Forests, Cloven Hoofed Big Game Animals of Alberta (Edmonton: Queen's Printer, 1969).

<sup>2</sup>For further information on fish see: Department of Lands and Forests, Angling Information Map (Edmonton: Queen's Printer, 1968).



in the above mentioned streams. Sturgeon occur in small numbers from the confluence of the Bow and Oldman Rivers to the Saskatchewan border.

Other native species occurring in the region include the sauger, goldeye, and lake trout. The goldeye and sauger are common in the South Saskatchewan River. Lake trout are native to the Waterton Lakes in the southwest corner of the region. Although introduced to several other lakes in Southern Alberta, they are relatively scarce.

Introduced--Brook trout, brown trout, rainbow trout, and golden trout have been successfully introduced. Brook trout and brown trout are common in several water courses in the Rocky Mountains and the foothills. Rainbow trout are common in pothole lakes, reservoirs, and streams throughout Southern Alberta. Golden trout have been established in a few alpine lakes in the extreme southwest corner of the province.

Other introduced species include the yellow perch and the walleye. Walleye are fairly common in the lower stretches of the South Saskatchewan River; yellow perch are common in the warm water lakes of Southern Alberta.

#### Summary

The South Saskatchewan and Milk River Basins contain a wide variety of fish and wildlife. As these river basins become further developed, fish and wildlife populations will certainly be affected. Water resource development plans currently being investigated may drastically affect fish and wildlife by altering their habitats.



## CHAPTER III

### THE ECOLOGICAL IMPACT OF ALTERNATIVE WATER RESOURCE DEVELOPMENT PROPOSALS

Approximately 20-25 proposed reservoir sites are under consideration for the region.<sup>1</sup> This chapter analyzes the probable effect of the proposed water resource development projects on waterfowl, upland game birds, big game, and fish. Harvestable numbers of fish and wildlife both at present and after reservoir construction for each of the proposed project areas must be obtained before the economic costs and/or benefits of any project can be determined. All such information currently available is summarized in the remainder of this chapter.<sup>2</sup>

#### Ecological Impact of Water Resource Development Projects on Waterfowl Production in Southern Alberta<sup>3</sup>

##### Little Effect

The following reservoir sites, if constructed, would have little effect on waterfowl production: Azure, Bow-Highwood, Cataract, Elbow, Eyremore, Highwood-Longview, Jumpingpound #1, #3 and #4, Mosquito Creek #1,

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<sup>1</sup>Information on proposed reservoir sites was obtained from Jay Purnell, Planning Engineer, Water Resources Division, Alberta Department of Agriculture, Interview, Edmonton, Alberta, May 16, 1969.

<sup>2</sup>The remainder of this chapter is based entirely on letters received from biologists. The information which follows each of the section headings was provided by the biologist cited at the beginning of the respective section.

<sup>3</sup>H. R. Weaver, Biologist, Canadian Wildlife Service, Personal Letter, Edmonton, Alberta, September 2, 1969.



Oldman Gap, Pekisko Creek, Pincher Creek, Sheep River, Sheppard Creek, Three Rivers, and Willow Creek (Figure 2). Most of these sites are located in the foothills west of Alberta's important waterfowl producing areas. The lands surrounding these sites generally have low waterfowl producing capabilities. Any losses of waterfowl breeding habitat in the inundated areas would probably be offset by the reservoirs which would be created. Intensive and extensive management procedures, requiring controlled water levels, would have to be implemented before production would be significantly affected.

#### Slight Advantage

Three reservoir sites, if constructed, would have a slight advantage for waterfowl production: Jumpingpound #2, Mosquito Creek #2, and the Little Bow River (Figure 2). Since it is difficult to make generalizations without knowing the degree of seasonal fluctuations in water levels, the following comments are based on the assumption that there will be less than 10 inches vertical change in water levels between mid-April and late August. If vertical change is greater than 10 inches, development of the above three sites would have little effect on waterfowl production. In all cases the quality of waterfowl nesting habitat that would be created is inversely related to the degree of seasonal fluctuations of water levels.

Nearly two miles of gently sloping shoreline would be created along the western and southwestern shores of Mosquito Creek Site #2 (FSL = 3,420 feet) if the site was constructed.<sup>1</sup> In addition, a good delta area might be created where the two streams would enter the reservoir at the north and northwest. However, if the reservoir were

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<sup>1</sup>FSL refers to the flood stage level of the reservoir site.



subject to extreme seasonal fluctuations, fewer birds would be produced in the area.

Construction of a two-mile ditch from Mosquito Creek Site #2 into Silver Lake would greatly increase waterfowl production there. At present, Silver Lake is a good waterfowl production area. However, water from the construction of such a ditch would minimize the effect of the severe summer drawdown in the area and greatly increase its waterfowl production.

Construction at the Little Bow River Site (FSL = 3,125 feet) would create four miles of gently sloping shoreline north of the dam site. Four miles of good shoreline would also be created south of the dam site. The southern end of the reservoir would contain two islands, which could provide nesting habitat for geese. The waterfowl nesting habitat that would be inundated would be more than compensated for if water levels were held stable.

#### Great Effect

The canal from Mosquito Creek Site #1 south via Clear Lake to the Oldman River at 30-10-24-4th is of greatest concern from the standpoint of waterfowl. The proposed canal route south of Mosquito #1, which passes through or near numerous sloughs, marshes, and lakes, could have a greater effect on waterfowl production than all of the above mentioned reservoir sites combined. "With proper routing of the canal and adequate water level control, the existing wetlands along the way could be improved, new wetlands could be created and the area's waterfowl production significantly increased."<sup>1</sup> On the other hand, much good breeding habitat could be damaged or completely eliminated by channeling or draining Clear Lake and other wetlands along the proposed canal route.

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<sup>1</sup> H. R. Weaver, op. cit.



Installation of water control structures along the canal route stabilize water levels at optimum depths for waterfowl production and allow manipulations of water levels for control purposes. In addition, they would stabilize waterfowl lakes of low productivity for recreation purposes other than hunting.

The first wetland to be affected by the canal would be the long, narrow lake which extends southeast from 26-14-26-4th. At present, excessive water depth is a limitation to optimum production. Stabilization at a lower level would increase duck use by creating a series of smaller, shallow marshes, which would provide more suitable nesting conditions. If the canal were to pass just west of this lake, a control structure near the center of Section 23 would ensure the development of optimum vegetation through the manipulation of water levels.

If the canal entered Clear Lake in the NE $\frac{1}{4}$  of Section 12, the lake could be stabilized several feet higher than its present level, thus improving its usefulness for recreation by people in the surrounding area. Fishermen currently gain access to the lake through a picnicking and boat launching area on the west shore. At present, this lake produces only a moderate number of waterfowl for its size. Intensive management would be required to increase production significantly.

Construction of a control structure between Clear Lake and the adjoining wetland to the west at 1-14-26-4th might greatly increase the productivity of this wetland. By stabilizing it at its early spring levels, a short ditch from the proposed canal to the lake at 35-13-26-4th would allow stabilization at a lower water level, thereby facilitating increased waterfowl production. Several good nesting islands might be created by lowering the water level of the lake.



The lake in 19-13-25-4th, the marsh in 8-13-25-4th, and the marsh in 25-13-26-4th are currently productive waterfowl areas. However, stabilization at spring levels would increase productivity. Stabilization and manipulation of water levels could be accomplished providing the canal passed near, but not through, these areas.

Stabilization of Clear Lake at the proposed FSL = 3,150 feet would restore a very good marsh at 13-12-25-4th. At present, this area is subject to severe drawdown to the extent that it is dry by late spring in most years. Stabilization would increase the productivity of this area for waterfowl and provide a fall staging area for waterfowl produced on the surrounding small wetlands.

Numerous small wetlands along the remainder of the proposed canal route in 31,29,20,17-11-24-4th are of high waterfowl production capability. Production is limited only by a lack of permanent water in the area. The canal could provide for this need, but channeling through these wetlands would eliminate them.

In general, the proposed canal route passes through a natural, low-lying drainageway in an area where the wetlands are currently producing large numbers of waterfowl. An aerial survey between Mosquito #1 and the Oldman River in mid-August showed an estimated 13,900 ducks using the wetlands discussed above.<sup>1</sup> The installation of water control structures and the manipulation of water levels in the larger lakes and marshes can improve significantly existing waterfowl habitat along a 22 mile stretch of the proposed canal. In addition, the creation of nesting islands, either

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<sup>1</sup>Count made by C. H. Lacy, Ducks Unlimited, and H. R. Weaver, Canadian Wildlife Service, during a single south-to-north aerial pass at low elevation along the proposed canal route on August 14, 1969. It can be assumed that most of these were local birds which nested or were produced in the immediate vicinity.



artificially or through lowered water levels, would provide habitat for a breeding population of Canada geese. On the other hand, irreparable damage would result to existing wetlands if the canal were channeled through them. Much good breeding habitat would be destroyed.

The proposed Crowfoot Creek Reservoir Site may also have considerable effect on the waterfowl resource potential in Southern Alberta. No areas of high waterfowl production capability would be inundated. Because the reservoir would provide permanent water for brood use, waterfowl landforms to the northeast, east, and south of the dam site would be improved.

Without any planned habitat improvement, the reservoir would create about 50 miles of fair to good quality nesting shoreline if water level fluctuations were not too severe. With the exception of one island in 20,21-23-21-4th, nearly all the better habitat would be in the shallow bays or delta areas where creeks flow into the reservoir. The locations and approximate number of shoreline miles that would be created are as follows: 23,24-23-22, 5 miles; 26,29-24-22 to 1-24-22 and 6-24-21, 17 miles; 21-24-21 to 3-24-21, 12 miles; 17-24-20 to 32-23-20, 9 miles; and 1,2-24-21, 5 miles.

If severe fluctuations in water levels were to occur annually, construction of small dams along the tributary creeks flowing into the above bays should be considered. With severe fluctuations in water levels, these dams might prove more beneficial to waterfowl production than one large reservoir. Small dams along creeks in 19-23-21, 13-24-22, 15-24-21, and 6-24-24 might or might not be feasible from engineering and economic standpoints. Each dam would have to be evaluated on its own merits.

The reservoir would have several other possibilities for management inputs. In addition to the island in 20,21-23-21 that would be created through inundation of the reservoir site, other islands could be



created through construction of ditches. A short ( $3/8$  mile), wide, deep, uncontrolled ditch in SW6-24-20 would isolate nearly 1250 acres. Two arms of the reservoir in NW2-24-21 could be connected by a short ( $1/4$  mile), wide, deep, uncontrolled ditch. The resulting island would be about 775 acres in size. These islands would likely facilitate a significant increase in the nesting population of Canada geese in this part of the province. Large numbers of colonial nesters such as terns and gulls would also benefit from these islands.

Another possibility for habitat improvement exists in the low lying, depressional area in NW4, SE8-24-21. This area lies at or below the proposed FSL = 2,825 feet. Flooding of the depression area through ditching would create  $4\frac{1}{2}$  miles of shoreline. An additional five islands, which would total approximately 4,550 acres and  $4\frac{3}{4}$  miles of shoreline, might also be created. A more detailed investigation would be required, however, to fully assess the possibilities for increasing waterfowl production in this area.

In general, the benefits of developing the Crowfoot Creek Reservoir Site would significantly outweigh any losses to waterfowl. Even if the reservoir did not increase waterfowl production in the reservoir or nearby wetlands (both of which possibilities are highly unlikely), its value as a migration stop would be a plus factor for waterfowl.

#### Effects of Irrigation Project Developments on Waterfowl<sup>1</sup>

Associated with the reservoir sites discussed above will be a system of canals and ditches that will transport water to irrigation areas.

In those cases where waterfowl use is compatible with the primary agricultural function and adequate water is available, additional

<sup>1</sup>C. H. Lacy, Provincial Biologist, Ducks Unlimited, Personal Letter, Edmonton, Alberta, September 10, 1969.



sub-impoundments could be created for water storage (mainly for waterfowl habitat) in conjunction with associated systems of dikes and supply canals to supply water to shallower marsh and pothole type habitat. Such habitat development has proven valuable in both the Eastern and the Western Irrigation Districts and could quite conceivably be extended as a complement to new irrigation works elsewhere.<sup>1</sup>

In order for migratory waterfowl to benefit from the development of irrigation-type habitat, certain considerations should be given to site selection and subsequent management. The following recommendations provide general guidelines for the development and management of this type of habitat.

#### Waterfowl Production Wetlands

In general, there are three basic types of waterfowl production habitats. The first consists of a large marsh containing all the conditions necessary for breeding waterfowl. A second consists of a group of wetlands, none of which singly provides all the needs of breeding waterfowl, but which in aggregate provide all the needs of waterfowl, such as food, open, dry sites, nesting sites, and cover. Still another type of development occurs when a series of small, low head dams are supplied from a storage reservoir upstream. If the dams are held at full level through most of the summer, such areas are far more productive than similar areas left in their natural state and allowed to recede indiscriminately.

#### Site Selection

Large marshes should be designed so that as great a water area as possible is less than three feet in depth. In addition, provision should be made for an extra foot or two of water to control emergent vegetation. In pothole type developments the depth should be as great as water availability will allow to prevent the establishment of emergent vegetation that may otherwise greatly reduce the value of the pothole to waterfowl.

<sup>1</sup> Ibid.



### Water Management

Waterfowl production wetlands can be supplied with water by various means, such as canals, pumping, and siphons. Where topography permits, it is preferable to supply each wetland with water independently of any other wetland.

### Water Level Management

"Though seasonal availability of water surpluses from agricultural uses frequently dictates the time of water intake, wetlands are generally most productive if full in the spring and at lowest levels in the fall."<sup>1</sup> It is preferable to lower water levels in the fall to the point where extensive mud flats are exposed and then to re-flood in the spring, holding at a constant level throughout the summer. This procedure facilitates the production of waterfowl food plants.

### Siltation

Premature filling of lakes by siltation can be reduced if silt laden water from agricultural use is delivered as near as possible to the outlet of a marsh. Although it is sometimes desirable to provide a settling basin upstream, this is probably not feasible in most cases.

### Ecological Impact of Proposed Reservoir Sites on Big Game and Upland Game Birds in the Calgary Region of Southern Alberta<sup>2</sup>

The following are gross evaluations of the effects of proposed water impoundments on wildlife. To evaluate properly the ecological loss of game animals would take a hundred or even hundreds of years because so many changes can occur over such a long period. Also, the indirect

<sup>1</sup> Ibid.

<sup>2</sup> Harold Carr, Regional Wildlife Biologist, Fish and Wildlife Division, Department of Lands and Forests, Personal Letter, Calgary, Alberta, October 24, 1969.



effect of the dams is a major consideration. Some of these considerations are discussed. However, other effects not obvious at the time of construction may be far more disastrous or beneficial than those that can be projected readily.

#### Azure

At present this area supports good pheasant and Hungarian partridge populations. Flooding would eliminate cover which is especially important during severe winters. The result might be the loss of approximately 200 birds per year. Big game losses would be negligible.

#### Mosquito Creek #2

Although cover that is presently being used by pheasants and Hungarian partridge in the area would be flooded, additional cover would be created along the shorelines. Deer are scattered throughout the area, but the loss would be negligible.

#### Cataract

"The water in this impoundment would lap against the base of some of the best big game winter ranges in Alberta. These ranges in the past have supported over 100 head of elk, although present numbers are about 50."<sup>1</sup> Approximately 100 sheep and numerous deer also winter in the area.

Construction of the impoundment itself "would not adversely affect these animals unless it interferes somewhat with movements." But the combination of erosion through wave action and road construction right adversely affect range habitat. In addition, human activity associated with the dam in the area could be highly detrimental. However, "this could be minimized with careful planning and construction of roads, preferably on the south side of the impoundment." A total of about 6-8 moose and 20 deer would be lost in the flooded area. Loss of birds would be negligible.



Pekisko Creek

Although good game area is involved, the loss would be minimal because the area flooded supports only about 2 moose and 6 deer. A few game birds would be lost.

Sheppard Creek

Up to 150 elk winter in the area near the proposed site. Although elk apparently use the area extensively in some years, it is difficult to ascertain how important the actual area of flooding would be to these elk.

Approximately 5 moose and 10 deer would be lost due to flooding of the site. The loss of upland game birds would be negligible.

Highway 212

The site supports little habitat for game birds and big game. Therefore, the loss would be negligible.

Jumpingpound #1

The area that would be flooded is not used extensively by game animals or birds. A few deer would probably be eliminated by the impoundment.

Jumpingpound #2

Flooding of this area would probably eliminate up to 15 deer and possibly a few moose. A few grouse would also be lost.

Jumpingpound #3

The area involved is excellent moose and deer range. Because the area is very small, however, only a few moose and deer would be lost. A few ruffed and spruce grouse would also be lost.

Jumpingpound #4

The general area probably supports the best moose range in the Calgary region. The impoundment would flood habitat that supports about 15 moose and 15 deer. A number of deer use the periphery of the proposed



impoundment. In addition, a few elk also use the area. The same area also provides good grouse habitat. At certain times it may contain a few hundred grouse.

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The area that would be flooded is of low productivity for big game animals. However, a few moose probably inhabit the area. The valley of Quirk Creek has been used heavily by elk during some winters.

Road construction and human activity associated with the dam may adversely affect elk and sheep that winter on nearby Powderface and Forget-Me-Not ridges. However, it is difficult to assess the effects of the proposed impoundment because of inconsistencies in migrations of the animals involved.

#### Sheep River

Of all the dam sites discussed this site probably would be the most disastrous from the wildlife standpoint. It is in excellent game range, has very good game populations with potential for more and stands to be damaged the greatest.<sup>1</sup>

Supporting approximately 80 sheep, the slopes of the north side of the proposed impoundment provide one of the main sheep wintering ranges in the Calgary region. In addition to possible range damage, human activity and harassment would be detrimental to the sheep.

Although it is difficult to predict, the sheep might possibly be prevented from reaching their winter ranges by the impoundment because it would flood their traditional migration routes. Thus, adverse effects of the proposed impoundment may eliminate the sheep because Rocky Mountain bighorn sheep are quite habitual in their migrations and ranges.

In addition to sheep, there are many deer, elk, moose, and grouse in the area. The area that would be flooded probably supports 6 moose and 25 deer. Sheep occasionally use the area for grazing and salt licks.



The area presently supports about 25 deer. Most of their range would be inundated. The area is also important to upland game birds, particularly for winter cover. There are probably around 2000 pheasants involved.

The effect of the impoundment depends on the cover that develops around it. It is doubtful that much cover will develop along the shoreline for several miles above the dam unless the FSL is reduced to below 3,300 feet. The effects of the impoundment on pheasant populations might be highly detrimental if no vegetation develops along the shores or on the low areas near the impoundment.

Ecological Impact of Proposed Reservoir Sites on  
Big Game and Upland Game Birds in the Lethbridge  
Region of Southern Alberta<sup>1</sup>

In general, none of the proposed reservoir sites in the Lethbridge region, if constructed, would benefit big game or upland game birds. In some cases game populations would be unchanged, but in most cases populations would decrease. The effects of the proposed reservoir sites are discussed below.

Mosquito Creek #1

Pheasants are the only game that would be affected by flooding of the site. Because pheasant populations are low in the area, the number lost would be minimal.

Little Bow River

Flooding of excellent cover would be detrimental to pheasant populations, which are high in several areas. Sharp-tailed grouse would

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<sup>1</sup>Gaylan Armstrong, Regional Wildlife Biologist, Fish and Wildlife Division, Department of Lands and Forests, Personal Letter, Lethbridge, Alberta, July 15, 1969.



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decrease slightly in number. Mule deer habitat in the area would practically be eliminated. However, because mule deer populations are of light density in the area, the number lost would be minimal.

#### Willow Creek

Sharp-tailed grouse populations would decrease significantly because medium to high densities occur in many localities. Ruffed grouse populations would decrease slightly. Both mule and white-tailed deer populations would also decrease slightly, but moose populations would remain unchanged.

#### Oldman Gap

Although effects are hard to judge, ruffed, blue, and spruce grouse populations would be reduced slightly. However, because they are abundant along the site's entire route, mule deer populations would be reduced drastically.

Elk, now numbering approximately 1000 head, would also be affected greatly. Limited summer and winter ranges would be flooded in the Racehorse and Dutch Creek areas. Flooding of the creeks leading to the Oldman River would alter favorite migration routes. Alternation of these routes could reduce use of summer and winter ranges west of the Kananaskis road. Thus, elk may be forced to use inferior ranges. In addition, hazards along the different routes may also affect population numbers.

#### Pincher Creek

Sharp-tailed grouse, pheasant, and Hungarian partridge populations would remain unchanged if the area were inundated. Mule and white-tailed deer populations would decrease slightly.

#### Three Rivers

Sharp-tailed grouse, Hungarian partridge, and ruffed grouse populations would decrease slightly. White-tailed deer populations would



also decrease slightly. However, flooding of the area would eliminate good mule deer habitat. Because medium to high densities of mule deer utilize the area, the population decrease would be moderate to heavy.

#### Effects of Canals on Upland Game Birds<sup>1</sup>

In conjunction with the proposed water resource development schemes, a number of canals may be constructed for irrigation purposes or water diversion (i.e., the proposed canal between Mosquito Creek Site #1 and the Oldman River). If these canals are to benefit upland game birds, the following two factors must be given serious consideration.

The first concerns construction of the canals. If these canals are constructed so that existing wetland areas are drained into the canals, upland game bird populations may be affected adversely. The extent of effect is directly dependent on the value of the particular wetland to upland game birds.

A second factor concerns management of the canal banks. These canals could provide valuable winter and nesting cover for upland game birds if they are not grazed, mowed, or burned each year. Lack of winter cover is the major limiting factor on upland game populations in Southern Alberta.

In general, the value of future canals to upland game birds depends upon the consideration that is given to upland game birds in the planning and management of the respective canals. Since canals can have an extensive effect on upland game birds, as well as waterfowl, it is important that wildlife management personnel be included in the planning and management of such projects.

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<sup>1</sup>Morley W. Barrett, Regional Wildlife Biologist, Fish and Wildlife Division, Department of Lands and Forests, Personal Letter, Lethbridge, Alberta, January 8, 1970.



Ecological Impact of Proposed Reservoir  
Sites on the Sport Fishery in the Calgary  
Region of Southern Alberta<sup>1</sup>

Most of the proposed reservoirs are to be located on major rivers near their headwater regions and are thus situated so as to influence, beneficially or otherwise, a significant portion of their downstream length. It may be said, without exaggeration, that these reservoirs will be the key to each river ecosystem; having the power to remove existing limiting factors such as water temperature and flow fluctuations or imposing additional constraints on the system; diurnal fluctuations, etc. For these reasons, the value or damage caused by each of these reservoirs to the sport fisheries in the area depends almost entirely on how man intends to manage them.<sup>2</sup>

In view of the above, various measures should be considered if the sport fishery potential of each of the reservoirs and tailwaters is to be realized. These measures are as follows: (1) establishment of minimum discharges for each river, (2) minimization of annual and daily fluctuations in downstream discharges, (3) incorporation of facilities in dams to permit discharges to be drawn off at the level of most desired temperatures, (4) clearing of debris from reservoir sites prior to impoundment, (5) stabilization of soils on the shoreline of the impoundment as well as on upstream watersheds, (6) minimization of draw-downs on the reservoir, (7) selection of the FSL so as to maximize the value of the impoundment shorelines for recreational use, (8) construction of boat launching sites, parking lots, camping facilities, etc., around reservoirs, (9) assurance of public access by purchasing sufficient lands on reservoir shorelines, and (10) selection of reservoir sites with sufficient depth to prevent winter-kill of fish.

At the present time neither the Fish and Wildlife Division nor the Water Resources Division can provide the data that is absolutely necessary

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<sup>1</sup>Dennis McDonald, Regional Fishery Biologist, Fish and Wildlife Division, Department of Lands and Forests, Personal Letter, Calgary, Alberta, February 4, 1970.

<sup>2</sup>Ibid.



to evaluate properly the effects of the proposed impoundments. Nevertheless, the following comments on each of the reservoir sites should give some indication as to how the fishery potential will be affected at each site.

#### Sheep River

The area that would be flooded is currently the most valuable portion of the Sheep River to the sport fishery. With the exception of the Sheep River Valley below the dam, all suitable camping areas would be inundated. Access would be blocked to Coal Creek, Dryson Creek, and the Junction Mountain area.

Even if the reservoir were managed properly, its value for fishing would be moderate to poor because of the unstable nature of the shoreline that would be created, the low productivity of waters in the area, and the heavy silt load carried by the rivers following heavy precipitation. Physical barriers in the streams adjacent to the proposed reservoir would eliminate spawning areas for rainbow trout.

#### Cataract

The reservoir would inundate a portion of the Highwood River that has a low fishery value at present. Although silting might present a serious problem to the reservoir's fishery potential, the sport fishery could be improved if the reservoir were built and properly managed. However, the reservoir would block access to the Upper Highwood Valley, as well as to other areas both north and south of the site.

#### Jumpingpound #1

The sport fishery potential in this area is excellent at this time with good numbers of rainbow trout, brook trout, and Rocky Mountain whitefish. Large concentrations of the latter species have been observed in



the area during recent years. These fish may be migrants from the Bow River moving into the area to spawn. If this is the case, the dam would probably eliminate these fish by obstructing their movement. Public access to the stream is a serious problem throughout the site area because of lack of cooperation from landowners. Should the reservoir be managed for rainbow trout on a put-and-take basis, it probably could provide an excellent fishery.

#### Jumpingpound #2

If managed properly, this area could support a good rainbow trout fishery. Annual stocking would be required.

#### Jumpingpound #3

Several miles of good quality trout stream would be inundated in the site area. Because the reservoir would be fairly shallow, it might result in a detrimental warming effect in the tailwaters, thus reducing their quality for trout. Provided the reservoir was stocked annually and managed properly, its potential as a sport fishery would be fair to good.

#### Jumpingpound #4

The fishery potential in the area is low due to heavy silt loads in Muskeg Creek, low summer flows, and lack of adequate bank cover. Flooding of the large muskeg area at the site would create conditions unsuitable for a good sport fishery.

#### Elbow

The portion of the Elbow River that would be inundated has a very low sport fishery potential. However, the reservoir would destroy an area of the river valley that is used extensively by campers, picnickers, etc. The reservoir would also block access to the Howard Creek area. Unless managed specifically for fisheries, a reservoir at this site would probably not improve significantly the area's fishery potential because of



the turbid condition of the area's water and the high rate of siltation that would occur.

#### Highwood-Longview

Although access is a problem at present, the fishery potential of this portion of the river is good. The impoundment might prove detrimental to the large population of rainbow trout currently in the Bow River between Calgary and Carseland as present evidence indicates that these fish migrate up the Highwood past the reservoir site to spawn in the tributaries of the Highwood River. Creation of a reservoir in this area probably would not improve the sport fishery because a heavy degree of siltation would occur in the reservoir.

#### Pekisko Creek

The area that would be inundated presently supports a relatively good fishery for rainbow trout. If it were managed properly, an impoundment could support a good rainbow trout fishery.

#### Sheppard Creek

"An impoundment in this area would undoubtedly increase the fishery potential as none exists now." However, the reservoir would have to be managed to maximize benefits to the sport fishery.

#### Bow-Highwood

"The portions of these rivers that would be flooded represent some of the most valuable potential sport fisheries areas in Alberta at this time."<sup>1</sup> If existing problems such as access, water pollution, etc., were solved, these areas could be utilized intensively. A reservoir in this area would also have a high potential for a sport fishery although annual stocking probably would be necessary. But the value of the reservoir for

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<sup>1</sup>Ibid.



recreation would be seriously impaired if the problems of water pollution from the City of Calgary were not eliminated in future years.

The reservoir might also prove beneficial to the tailwater fishery below the dam provided that the discharges are managed to cool the tailwater. The rainbow trout fishery could be extended many miles beyond its current limit near Carseland to as far as Bassano or beyond. But the dam might also eliminate this population of trout by blocking the spawning migration between the Carseland dam and the tributaries of the Highwood River.

#### Azure

A minor fishery for rainbow trout presently exists in the area. An impoundment at the site might support a good rainbow trout fishery. However, annual stocking would probably be required to maintain a fishery. In addition, control of pollution by livestock upstream would be necessary to prevent excess enrichment and silting of the reservoir.

#### Mosquito Creek #2

The reservoir probably would support a rainbow trout fishery. If the reservoir could not support trout, a warm water fishery for pike and perch could be created. Either of the above would be beneficial as no fishery potential currently exists in the area.

#### Crowfoot Creek

The area's fishery potential would certainly be enhanced as the fishery potential in the area currently is low. Provided that problems such as nutrient enrichment from nearby agricultural lands are controlled, the high productive capability of the impounded area and its close proximity to Calgary (50 miles) would assure intensive utilization by recreationists. The large size of the reservoir (25,000 acres) would permit



other water oriented recreational activities to be carried on compatibly with angling, a factor lacking on many of the pothole fisheries of Alberta at this time."<sup>1</sup> If developed both as a sport fishery and as a provincial park, this reservoir might equal, if not exceed, Chain Lakes Reservoir in value.<sup>2</sup> The reservoir might support a warm water fishery for pike and perch, a cold water fishery for trout, or possibly both.

#### Eyremore

The river in the impoundment area supports a warm water fishery for goldeye and walleye. A reservoir at this location might support both warm water and cold water fish species. But the fishery potential in the area would be reduced by its distance from populated areas, the excessive rate of siltation that probably would occur, access problems (i.e., Indian lands surround part of the impoundment), and impoundment shoreline erosion, which might be excessive.

#### Ecological Impact of Proposed Reservoir Sites on the Sport Fishery in the Lethbridge Region of Southern Alberta<sup>3</sup>

Attention has been focused on most of the points that should be considered concerning sport fisheries. However, several additional points should be mentioned. First, impoundment water levels must be studied in detail as they can be used to control aquatic plant growth and will dictate the recreational use potential of the impoundment. It should be kept in

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<sup>1</sup>Ibid.

<sup>2</sup>From April 1 to December 31, 1969, 125,000 visitors came to Chain Lakes Reservoir. Approximately 90 percent stated that the main purpose of their visit was fishing. Data was obtained from John Ericksen, District Supervisor, Southern District, Provincial Parks, Interview, Lethbridge, Alberta, January 12, 1970.

<sup>3</sup>Gordon Haugen, Regional Fishery Biologist, Fish and Wildlife Division, Department of Lands and Forests, Personal Letter, Lethbridge, Alberta, October 10, 1969.



mind that reservoir elevations near the FSL should be maintained during peak recreational use (June-August). Second, if adequate sport fisheries are to be maintained in the tailwaters, a discharge must be maintained which is not less than the mean flow of the respective rivers for the ten years prior to impoundment. Finally, it should be reiterated that each reservoir will have to be treated individually and that cooperation among all agencies involved in construction and/or use of the impounded waters must be maintained throughout planning, construction, and management of the completed project.

The varied fishery potentials of the six reservoir sites are discussed below. Attention is given to impoundment and tailwater fisheries. It should be remembered that annual stocking of the impoundments would be necessary to maintain a quality fishery. The tailwaters, however, would be self-sustaining after initial stocking.

#### Pincher Creek

The proposed impoundment has good potential as a rainbow trout fishery. The fishery loss would be nil.

#### Three Rivers

Flooding of 10 miles of stream in the impoundment area would cause the loss of a fair rainbow trout and Rocky Mountain whitefish sport fishery. However, if managed properly, a tailwater fishery for rainbow trout and brown trout below the impoundment should more than compensate for the fishery loss.

#### Oldman Gap

Flooding of the impoundment area would result in the loss of a good cutthroat trout fishery, but the tailwater should provide an excellent fishery for brown as well as rainbow trout.

#### Little Bow River

The impoundment would have a fair potential for a brown trout or



walleye sport fishery. The fishery loss would be nil.

#### Mosquito Creek #1

The impoundment might have a fair potential for rainbow trout. The fishery loss would be negligible as no fishery potential currently exists in the area.

#### Willow Creek

The impoundment would have good potential for rainbow trout. But, flooding of streams in the impounded area would eliminate a fair rainbow trout fishery.

### Summary

Several of the proposed water resource development projects may be beneficial to waterfowl. Reservoirs at the following three sites may offer slight advantages to waterfowl production: Mosquito #2, Jumpingpound #2, and Little Bow River. However, the proposed canal, from the Bow River south to the Oldman River via Mosquito #1, and the Crowfoot Creek site have the greatest potential to increase waterfowl production. Populations of waterfowl probably would not decrease at any of the proposed PRIME project areas. Thus, there might be an overall increase in waterfowl habitat and in standing populations and harvestable numbers of waterfowl.

Upland game birds may benefit less from further water resource development. The following reservoir sites, if developed, would probably reduce upland game bird populations significantly: Azure, Bow-Highwood, Jumpingpound #4, Willow Creek, and Sheep River. On the positive side, the canal between the Bow-Highwood site and the Oldman River might prove beneficial to upland game birds, provided the wetlands along the route are not drained into the canal. In addition, significant increases in upland game bird populations might be realized from canals leading to new irrigation developments, provided that these canals do not drain existing wetlands



and that the canal banks are not grazed, mowed, or burned each year. In general, it is not possible to determine if there would be a net increase or decrease in upland game bird populations at this time.

In the case of upland game birds, losses to habitat in one area might be compensated for by improved habitat in other areas. However, most of the big game habitat that would be lost through inundation by impoundments could not be replaced. Significant losses to big game populations would probably result if impoundments are developed at the following sites: Cataract, Jumpingpound #4, Oldman Gap, Sheep River, Sheppard Creek, and Three Rivers. Indications are that development of the Sheep River and Oldman Gap sites would have the most unfavorable effects on big game populations. Although many of the sites, if constructed, would reduce big game populations, the information necessary to provide a reasonable approximation of the relative net decrease in harvestable numbers and populations of big game animals is not available.

The sport fishery could be improved considerably by the PRIME scheme. Preliminary investigation indicates that at all but four or five sites, the harvestable fishery potential may be increased if the sites are developed.

Unfortunately, complete information needed to evaluate properly the ecological significance of the proposed projects is not available at this time. Nevertheless, the above evaluations do provide valuable information which is useful in indicating the direction of change in harvestable numbers of game and fish, but not sufficient to allow the determination of changes in the economic costs and benefits of the respective projects.

Since physical changes and economic values are necessary to assess fully the impact of the above projects in economic terms, it is now necessary to determine economic values associated with the region's fish and wildlife resources. Although the ecological data was not sufficient for



evaluation purposes, an economic valuation will provide useful insights into the relative worth of fish, bird game, and big game. Such information will help indicate the economic significance of the proposed projects.



## CHAPTER IV

### ECONOMIC EVALUATION OF FISH AND WILDLIFE

#### Economic Framework

Fish and wildlife resources are capable of satisfying human wants and, therefore, take on social values. No attempt is made to determine these values other than those stemming from hunting and fishing activities. Many people benefit from seeing wildlife in natural habitat while others gain some satisfaction from simply knowing that fish and wildlife exist in the wild state. Still others consider fish and wildlife resources valuable yet may not take advantage of these resources until sometime in the future. While all of these values are considered important, they lie beyond the scope of this study.

#### Introduction

Fish and wildlife are not available in unlimited quantities. These resources are flow or renewable resources (i.e., they are available over successive time intervals).<sup>1</sup> Human action may increase any and/or all future flows. Minimum flows must be maintained to guarantee the availability of fish and wildlife. There are, however, costs of maintaining such flows. These costs may be partially covered by the recreationist through license fees. Costs in excess of any license fees may be borne by the general taxpayer. Other costs are absorbed by private landowners who provide habitat for fish and wildlife.

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<sup>1</sup>S. V. Ciriacy-Wanthurp, Resource Conservation Economics and Policies, 3rd ed. (Berkeley: University of California Press, 1968), pp. 37-38.



Before public expenditures can be allocated to fish and wildlife, the relative worths of the various species of fish and wildlife (i.e., the incidence of benefits received from these resources) must be known. Relative worths may help policy makers to determine appropriate license fees and to allocate expenditures for the support of hunting and fishing activities.

Many factors must be considered when determining the worth of fish and wildlife. A recreationist who pursues fish and/or wildlife incurs a variety of costs. In addition to license fees, costs include transportation, food, lodging, sporting equipment, and other miscellaneous items. Thus, the recreationist pays for a bundle of goods rather than just the chance to pursue fish or wildlife.

The satisfaction a recreationist receives from his activity must certainly be influenced by the above costs. Another consideration is the actual pursuit of fish and wildlife at the site. Recreationists receive value from anticipating success while hunting or fishing. Worth received by recreationists need not stem from actually being successful, but rather from the probability of success. In fact, only the probability of success is essential.

In addition to receiving those benefits from the recreation experience that are reflected in actual dollar expenditures, the recreationist may receive additional benefits over and above his expenditures. These are known as extramarket benefits.<sup>1</sup> Extramarket benefits are an important consideration in determining the worth of fish and wildlife resources. The benefit-cost framework presented below considers extramarket benefits, as well as other factors such as those mentioned above in deriving benefits

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<sup>1</sup>Ibid., pp. 239-248.



from Southern Alberta's fish and wildlife resources. Benefits are assessed from three points of view: individual recreationist's, society's in general, and the Province of Alberta's.

#### Value of the Individual's Recreation Experience

Valuation of the recreation experience is based on the five separate steps of which it consists: anticipation, travel to the site, on site activities, travel home, and recollection.<sup>1</sup> It is the hunting or fishing activity at the site that gives meaning to the outing, but the other steps are an integral part of the recreation experience. Anticipation or planning, travel, and recollection probably have a substantial bearing on what the recreationist is willing to pay to undertake an outing. It is difficult, if not impossible, to divide accurately the recreationist's expenditures over the above categories. The recreationist himself may not know what, if anything, he is willing to pay for the different parts of the recreation experience.

The gross value of this measure of benefit consists of license fees, extramarket benefits, and expenditures over and above those that would have been incurred by the recreationist had he foregone the recreation activity. Extramarket benefits constitute the net value of the recreation experience (i.e., the gross value less expenditures and license fees equals extramarket benefits). Valuation of the recreation experience provides an appropriate measure of the value of the resource to recreationists.

#### Society in General

A number of direct benefits and costs must be considered when

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<sup>1</sup> Marion Clawson, "Economic Aspects of Sport Fishing," Canadian Fisheries Report No. 4 (Ottawa: The Department of Fisheries of Canada, 1965) pp. 13-15.



deriving the net social value of the resource to society in general.<sup>1</sup> Direct benefits include license fees and extramarket benefits of both residents and non-residents.<sup>2</sup> Direct costs are the development, management, and operation costs for the resource.<sup>3</sup> The net social value to society in general is then determined by subtracting direct costs from direct benefits. This valuation provides a measure of the flow of net social benefits received directly in one year by all those who hunted or fished in the region. The total value of the resource is measured by the capitalization of annual net benefits.

#### Province of Alberta

The net social value of the resource to Alberta consists of net direct benefits plus net indirect benefits. Net direct benefits are license fees of both residents and non-residents plus extramarket benefits of residents less direct costs for development, management, and operation of the resource.<sup>4</sup> Net indirect benefits are the impact of non-resident expenditures in the region less extra expenditures or indirect costs incurred as a result of sales to non-residents.

The net social value of the resource provides a rough estimate of the value of the resource to the province. It is useful in determining whether or not benefits received are greater than the costs of providing the recreational activities associated with the resource.

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<sup>1</sup>All recreationists pursuing Southern Alberta's fish and wildlife resources are referred to as "society in general."

<sup>2</sup>The term "resident" used in this study refers to all recreationists living in Alberta. All recreationists not living in Alberta are referred to as "non-residents."

<sup>3</sup>Direct costs borne by other agencies and individuals are recognized, but not quantified in this study. These costs include providing access to the recreation site, etc.

<sup>4</sup>Non-resident extramarket benefits are excluded in this measure of benefit since the province receives no benefit from non-residents excepting actual dollars expended.



### Summary of the Measures of Benefits

All the measures of annual net benefits derived from sport hunting and fishing activities in the region have direct costs and benefits (Table 3).<sup>1</sup> Only the valuation of the resource to Alberta has indirect costs and benefits. Two measures of benefits indicate the worth of the resource to recreationists; the other gives the worth of the resource to the province.

Table 3

#### BENEFITS AND COSTS FOR THE INDIVIDUAL RECREATION EXPERIENCE, SOCIETY IN GENERAL, AND THE PROVINCE OF ALBERTA

| Item                 | Individual<br>Recreation<br>Experience                     | Society in<br>General                                                                                 | Province of<br>Alberta                                                            |
|----------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Direct<br>Benefits   | expenditures,<br>license fees,<br>extramarket<br>benefits  | resident and non-<br>resident license<br>fees, resident and<br>non-resident extra-<br>market benefits | resident and non-<br>resident license<br>fees, resident extra-<br>market benefits |
| Direct<br>Costs      | license fees,<br>expenditures                              | development,<br>management, and<br>operation costs<br>for the resource                                | development,<br>management, and<br>operation costs<br>for the resource            |
| Indirect<br>Benefits | --                                                         | --                                                                                                    | multiplier impact<br>of non-resident<br>expenditures                              |
| Indirect<br>Costs    | --                                                         | --                                                                                                    | extra expenditures<br>incurred as a result<br>of sales to non-<br>residents       |
| Net<br>Values        | Net Value of<br>the Individual<br>Recreation<br>Experience | Net Social Value<br>to Society in<br>General                                                          | Net Social Value to<br>the Province of<br>Alberta                                 |

<sup>1</sup>These measures of benefits are referred to as "annual net benefits" because they provide a measure of the value of hunting and fishing activities for only one year.



## Valuation Techniques

Southern Alberta's fish and wildlife resources provide outdoor recreation for many hunters and fishermen. These publicly owned resources may be extremely important to Alberta. Unfortunately, the market mechanism does not reflect effectively the value of fish and wildlife. Economic values must be determined to provide policy makers with a guideline for comparing resource use for fish and wildlife based activity with alternative uses of the same resource base. Although economic considerations are not the only relevant criteria for making fish and wildlife conservation decisions, knowledge of economic values will certainly aid policy makers in making decisions affecting future use rates of fish and wildlife resources.<sup>1</sup>

A number of techniques have been devised to value outdoor recreation resources in recent years. The most common method used involves determining the value of recreationists' expenditures. Other techniques utilized include alternative use cost method, consumer surplus methods (Trice-Wood, Hotelling, monopoly revenue, and cost saving), cost method, gross national product method, and market value methods. Although many of the above methods have severe limitations, they have provided valuable insights into valuing resources with non-priced components. Indeed, many of the methods now being utilized are variations of those mentioned above.

The latest methods utilized can be broadly classified into two categories, direct and indirect. The direct approach to resource valuation,

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<sup>1</sup>The term "conservation" as used in this study refers to the redistribution of physical use rates in the direction of the future. The economic opposite to conservation, "depletion," refers to the redistribution of physical use rates in the direction of the present. For a more detailed discussion of conservation as defined above see: S. V. Ciriacy-Wantrup, op. cit. p. 51.



such as that used in this study, attempts to determine willingness to pay for the resource on the part of the recreationist by asking him directly the magnitude in dollars of the benefits he receives.

Indirect methods attempt to impute willingness to pay from information relating to recreationists' observed behaviour, particularly their willingness to incur costs associated with the recreational activity. In this approach the total population from which recreationists come is stratified by distance zones in which the cost of traveling is reasonably consistent. This facilitates the determination of an expression relating participation rates to the level of travel and other costs. Participation rates for each population group under any hypothetical toll or charge can be projected from observed participation rates of similar populations with travel costs equal to those of the group in question plus the toll. A demand schedule can then be determined by applying predicted participation rates at various levels of toll to the number in the population. Adding these demand curves will yield an aggregate demand curve for the resource in concern.

The direct and indirect approaches have not been utilized to value Alberta's sport hunting and fishing resources in the past.<sup>1</sup> However, Brown, Singh, and Castle used the indirect approach in determining the economic value of the Oregon salmon and steelhead sport fishery.<sup>2</sup> Pearse used similar techniques in valuing big game hunting in the East Kootenay

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<sup>1</sup>W. S. Pattison recently completed an economic evaluation of this nature on moose hunting activity in Northern Alberta. See: W. S. Pattison "Moose Hunting Activity in Northern Alberta" (Unpublished M.Sc. Thesis, the University of Alberta, 1970).

<sup>2</sup>William G. Brown, Ajmer Singh, and Emery N. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Technical Bulletin 78 (Corvallis: Oregon Agricultural Experiment Station, 1964).



of British Columbia.<sup>1</sup> However, Pearse differed from others utilizing the indirect approach by stratifying the population of recreationists into income classes rather than distance zones. As far as can be determined, no study utilizing the direct approach has been undertaken on publicly owned sport fish and wildlife resources in the same region. The direct approach is being utilized in Alberta and other areas to value outdoor recreation resources other than fish and wildlife.<sup>2</sup>

The three measures of annual net benefits derived in this study depend upon the determination of extramarket benefits.<sup>3</sup> With the exception of extramarket benefits, all the necessary costs and benefits can be readily quantified. Obtaining an approximation of extramarket benefits is probably the most serious problem facing those evaluating recreational resources. However, the difficulties inherent in estimating non-priced benefits do not mean that the above techniques of evaluation serve no useful purpose. Caution should be used in interpreting the benefits derived in this study as the best techniques available in either direct or indirect approaches to resource evaluation provide only a rough estimate of extramarket benefits. Nevertheless, if discrepancies are large between the benefits and costs derived in this study, the policy implications have a stronger analytic foundation.

Extramarket benefits are usually determined in the direct approach by asking the recreationist a question such as "How much would you pay

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<sup>1</sup>Peter H. Pearse, "A New Approach to the Evaluation of Non-Priced Recreational Resources," Land Economics, XLIV (February, 1968).

<sup>2</sup>Peter Whiting and W. E. Phillips are currently undertaking an economic evaluation of the provincial parks in the South Saskatchewan River Basin of Southern Alberta.

<sup>3</sup>For a comprehensive discussion of extramarket benefits see: S. V. Ciriacy-Wantrup, op. cit., pp. 239-48.



(per day, week or season) for the privileges now offered?" Unfortunately, this approach may only measure the amount of money the recreationist has available for recreation.

A pensioner, for example, may receive considerable enjoyment from sport fishing--indeed it may be one of the few forms of recreation available to him--but may not have sufficient income to pay anything for fishing privileges without sacrificing some necessities of life.<sup>1</sup>

To minimize this problem the following question was asked in this study: "Approximately how much do you think a day's hunting (or fishing) is worth above what you spend on travel and other expenses?"

Asking the recreationist directly (rather than utilizing an imputation process such as is used in indirect methods) the value of the extramarket benefits he receives provides an appropriate measure of value, for the recreationist is probably in the best position to determine the value of the extramarket benefits he receives. However, some people feel it is either pointless or impossible to value fish and wildlife. Failure of the recreationist to value extramarket benefits in this study usually stemmed from one of the following three considerations: (1) the recreationist felt that a value could not be placed on fish and wildlife because they are "priceless"; (2) the recreationist stated that he did not understand the meaning of the question; (3) the recreationist felt that the question was a gimmick to raise license fees.<sup>2</sup> Most recreationists who expressed concern that the question about extramarket benefits would eventually lead to higher license fees, but still valued the resource,

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<sup>1</sup>R. A. Spargo, "Methods and Techniques of Evaluation of Sport Fishing," Canadian Fisheries Report No. 4 (Ottawa: The Department of Fisheries of Canada, 1965), p. 62.

<sup>2</sup>Success of recreationists in pursuing fish and wildlife may also have been a factor, but was not given consideration in this study.



usually stated that they received zero dollars in extramarket benefits.

Efforts were made to reconcile the differences in characteristics, if any, between recreationists valuing and recreationists not valuing extramarket benefits. The results of this analysis indicated no significant differences between mean expenditures, miles traveled, and days spent hunting or fishing for all residents.<sup>1</sup> Approximately 80 percent of all residents valued extramarket benefits.

The actual valuation of extramarket benefits by the recreationist may be influenced by such factors as bag limits, quality of the recreation experience, leisure time, costs and benefits incurred traveling to the site, and resources, such as restaurants, motels and highways, available to the recreationist on the way to or at the site. All these factors help to determine the extramarket benefits that the recreationist receives.

The case of a recreationist's travel to the site may help to illustrate the above point. A recreationist who receives benefits from travel which exceed his monetary cost will value his extramarket benefits more highly; thus, the value of the resource at the site will increase. It can be argued that this excess of benefits over monetary costs should not be attributed to the value of the resource at the site. However, this benefit is incurred because the recreationist is traveling to the site. At the other extreme the trip to the site may provide benefits that are less than the monetary cost of travel or are even negative benefits. In this case the site receives a lower valuation. The site is then worth less to the recreationist because of the real and intangible costs of traveling there. This explains why the resource is often worth more to those who live closer to the site (all other things being equal including length of

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<sup>1</sup>See Appendix I, Table VI, for appropriate data, test statistic, and test results.



stay). The valuation of the site is not affected when the monetary costs of travel equal the benefits gained.

## Data Requirements, Sampling Procedure, and Response

### Data Requirements

Subsequent to the benefit cost framework and relevant background theory discussed here, application of particular sampling procedures and data collection were carried out. The benefit-cost framework requires data on costs and benefits associated with the hunting and fishing activities undertaken in the region. The development, management, and operation costs of providing the above activities for hunters and fishermen were obtained from the Fish and Wildlife Division, Alberta Department of Lands and Forests. All data needed from hunters and fishermen were obtained from mail questionnaires.<sup>1</sup> The four basic types of data required were: (1) population of recreationists, (2) days hunted and/or fished, (3) extramarket benefits, and (4) expenditures.

The total population of recreationists in Alberta had to be determined before any sampling could be undertaken. Sampling then indicated the population of the respective groups of hunters and fishermen in the region. Days spent by recreationists hunting and/or fishing provided information necessary to determine total season benefits received by these recreationists. Extramarket benefits were an important component of all three measures of benefits derived in this study. Expenditures of recreationists were essential in estimating the value of the recreation experience, as well as the impact of non-resident expenditures in the region.

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<sup>1</sup>The questionnaires used for resident and non-resident hunters and fishermen are presented in Appendix II. Information which is asked on the questionnaires that is not necessary to meet the data requirements of this study will be used on a similar study (i.e., Ron Miller and W. E. Phillips are currently undertaking a study on hunting and fishing activities in Alberta).



Resident hunters--A 9.57 percent random sampling was taken of all hunters who held wildlife certificates during the 1968 hunting season.<sup>1</sup> Every tenth certificate was sampled from certificate files in a systematic manner.<sup>2</sup> Randomness was preserved by first choosing a number between one and ten inclusive as a starting point. No trend effect or groupings were evident.

The randomly sited systematic sample drawn from a population of 119,897 wildlife certificate holders indicated that 109,608 (91.42 percent) were residents and 10,289 (8.58 percent) were non-residents. Within the resident hunting population, 38,568 (35.19 percent) hunted in the South Saskatchewan and Milk River Basins of Southern Alberta.

Among the resident hunting questionnaires delivered to the addressee, approximately 31 percent were returned in suitable condition for analysis.<sup>3</sup> The resident questionnaires were divided into the following three groups: (1) bird hunters only, (2) big game hunters only, and (3) individuals who hunted both birds and big game. Separation of resident hunters into the above groups was made to permit a clearer picture of expenditures and extramarket benefits. This grouping of hunters revealed that during the 1968 season, 16,557 (42.98 percent) hunted birds only, 9,245 (23.97 percent) hunted big game only, and 12,751 (33.06 percent)

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<sup>1</sup>All resident and non-resident hunters must purchase a wildlife certificate before hunting in Alberta.

<sup>2</sup>The sample was less than 10 percent since many of the certificates sampled had handwritten names and addresses that were illegible or incomplete. Similar problems were encountered with all other random samples taken.

<sup>3</sup>Since there was no way to sample only from those hunting in the region, it was necessary to assume the percent response was the same for residents hunting in the region as it was for all resident hunters. A similar assumption was made for the other groups sampled.



hunted both birds and big game. The above figures do not account for any hunting that may have occurred outside the region.

A one percent personal follow-up sample was taken of all resident hunters included in the mail survey to determine whether or not non-response bias existed.<sup>1</sup> All hunters in the follow-up that could be contacted were interviewed in person or by telephone. If a hunter had responded to the mail survey, a questionnaire was randomly selected from those returned by mail to represent the reply of this hunter. Those who did not respond to the mail sample were asked to complete a questionnaire. These two groups of questionnaires were then combined. The means from this follow-up sample were then assumed to represent hypothesized values of the true population means for the following variables: days hunted, expenditures, miles traveled, and extramarket benefits. Comparisons between the follow-up sample and the mail sample were then undertaken.<sup>2</sup> This analysis indicated no non-response bias was evident for resident hunters.

Non-resident hunters--Questionnaires were mailed to 1,195 non-resident hunters. Most of the non-resident hunters sampled (970) were selected in the random sampling of wildlife certificates. An additional 235 were randomly selected by sampling approximately 25 percent, 50 percent, and 25 percent of the alien big game, non-resident Canadian big game, and non-resident white-tailed deer license holders, respectively. Additional samples of these groups were taken because they were relatively small in number in comparison to the other non-resident license groups.

The percent sampled for each of the non-resident hunter groups

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<sup>1</sup>The term "non-response bias" refers to bias arising from differences in activity, performance or characteristics between those who respond to questionnaires and those who do not.

<sup>2</sup>See Appendix I, Table VII, for appropriate data, test statistic, and test results.



was as follows: alien big game, 32.40 percent; non-resident Canadian big game, 58.73 percent; alien bird game, 9.57 percent; non-resident Canadian bird game, 9.57 percent; and non-resident white-tailed deer, 32.71 percent. Table 4 presents the sampling statistics for resident and non-resident hunters.

Table 4

SAMPLING STATISTICS FOR RESIDENTS AND NON-RESIDENTS HUNTING IN SOUTHERN ALBERTA DURING THE FISCAL YEAR ENDING MARCH 31, 1969

| License Group                   | Percent Response from Sampling | Percent Hunting in the Region | Number of Licenses Sold | Estimated Population Hunting in the Region |
|---------------------------------|--------------------------------|-------------------------------|-------------------------|--------------------------------------------|
| All Residents                   | 31.02                          | 35.19                         | 109,608                 | 38,568                                     |
| Alien Big Game                  | 41.79                          | 3.57                          | 644                     | 23                                         |
| Non-Resident Canadian Big Game  | 66.67                          | 13.64                         | 59                      | 8                                          |
| Alien Bird Game                 | 33.87                          | 52.42                         | 1,343                   | 704                                        |
| Non-Resident Canadian Bird Game | 36.06                          | 57.46                         | 4,248                   | 2,441                                      |
| Non-Resident White-Tailed Deer  | 31.25                          | 20.00                         | 255                     | 51                                         |

Resident fishing--A 9.50 percent random sampling of 139,253 resident and non-resident Canadian fishing license holders revealed that 98.00 percent were residents and 2.00 percent were non-resident Canadians.<sup>1</sup> Thus, 136,465 residents purchased fishing licenses during the 1968-69 fishing season.<sup>2</sup>

<sup>1</sup>The same license was issued to resident as to non-resident Canadians.

<sup>2</sup>Since all residents under 16 years of age are not required to purchase fishing licenses, the actual resident fishing population would be considerably higher.



Approximately 18 percent of the questionnaires delivered to the addressee were returned in suitable form for analysis. These questionnaires indicated that 43,315 (32.54 percent) of the residents fished in the region at least once during the season.

Non-resident fishing--The 9.50 percent random sampling of resident and non-resident Canadian fishermen revealed that 2,788 were non-resident Canadians. This figure, coupled with the 1,621 alien fishing license holders, constituted the 4,409 alien and non-resident Canadian fishermen fishing in Alberta during the 1968-69 season. A 24.06 percent random sample was taken of the alien fishing license holders.

Approximately 18 percent of the non-resident Canadian and 29 percent of the alien questionnaires were returned in suitable form for analysis. These questionnaires indicated that 1,232 (44.19 percent) of the non-resident Canadians and 524 (32.38 percent) of the aliens fished in the region. Sampling statistics for resident and non-resident fishermen are summarized in Table 5.

Table 5

SAMPLING STATISTICS FOR RESIDENTS AND NON-RESIDENTS FISHING IN  
SOUTHERN ALBERTA DURING THE FISCAL YEAR ENDING MARCH 31, 1969

| License Group         | Percent Response from Sampling | Percent Fishing in the Region | Number of Licenses Sold | Estimated Population Fishing in the Region |
|-----------------------|--------------------------------|-------------------------------|-------------------------|--------------------------------------------|
| Residents             | 18.48                          | 32.54                         | 136,465                 | 44,406                                     |
| Non-Resident Canadian | 17.77                          | 44.19                         | 2,788                   | 1,232                                      |
| Alien                 | 29.17                          | 32.38                         | 1,621                   | 524                                        |



## Summary

Sampling all sportsmen hunting and/or fishing in the Province of Alberta was necessary to obtain data on hunting and fishing activities in Southern Alberta during the fiscal year ending March 31, 1969. This sampling revealed that there were approximately 88,000 licenses sold to recreationists hunting and/or fishing in Southern Alberta during the above year. The information obtained from these recreationists is the basis of the evaluation presented below.

## Economic Evaluation of Fish and Wildlife

The benefit-cost framework and the sampling of recreationists constitute the necessary preliminaries for determination of three types of annual net benefits arising from the fish and wildlife resources in the South Saskatchewan and Milk River Basins of Southern Alberta. The valuation of the individual recreation experience, the value of the resource to society in general, and the value of the resource to the Province of Alberta are determined below.

### Value of the Individual Recreation Experience

The gross values of the recreation experience (i.e., expenditures, license fees, and extramarket benefits) were approximately \$5,181,000 for resident hunters and \$6,247,000 for resident fishermen or \$11,429,000 for all residents (Table 6).<sup>1</sup> Gross values were \$996,000 for non-residents (\$836,000 for hunters and \$160,000 for fishermen).<sup>2</sup> Thus, the total gross value of the recreation experience for all hunting and fishing activities

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<sup>1</sup>See Appendix II, Tables II-V, for a detailed breakdown on resident and non-resident recreationists.

<sup>2</sup>Only expenditures of non-residents while in Alberta were used in calculating gross values. Thus, gross values will be lower than if all non-resident expenditures were included. However, net values will not be affected since they consist of extramarket benefits only.



in Southern Alberta during the fiscal year ending March 31, 1969, was \$12,425,000.<sup>1</sup>

Table 6

VALUE OF THE INDIVIDUAL RECREATION EXPERIENCE FOR ALL HUNTING  
AND FISHING ACTIVITY IN SOUTHERN ALBERTA DURING THE  
FISCAL YEAR ENDING MARCH 31, 1969

| Item                    | Number of<br>Licenses | Average Per<br>License | Totals              |
|-------------------------|-----------------------|------------------------|---------------------|
| Gross Values            |                       |                        |                     |
| Resident hunters        | 38,568                | \$134.34               | \$5,181,225.12      |
| Resident fishermen      | <u>44,406</u>         | <u>140.69</u>          | <u>6,247,480.14</u> |
| Total All Residents     | 82,974                | 137.74                 | 11,428,705.26       |
| Non-Resident hunters    | 3,227                 | 258.99                 | 835,760.73          |
| Non-Resident fishermen  | <u>1,756</u>          | <u>91.23</u>           | <u>160,199.88</u>   |
| Total All Non-Residents | 4,983                 | 199.87                 | 995,960.61          |
| TOTAL GROSS VALUE       | 87,957                | 141.26                 | 12,424,665.87       |
| Net Values              |                       |                        |                     |
| Resident hunters        | 38,568                | 80.90                  | 3,120,151.20        |
| Resident fishermen      | <u>44,406</u>         | <u>98.31</u>           | <u>4,365,553.86</u> |
| Total All Residents     | 82,974                | 90.22                  | 7,485,705.06        |
| Non-Resident hunters    | 3,227                 | 97.47                  | 314,535.69          |
| Non-Resident fishermen  | <u>1,756</u>          | <u>19.36</u>           | <u>33,996.16</u>    |
| Total All Non-Residents | 4,983                 | 69.94                  | 348,531.85          |
| TOTAL NET VALUE         | 87,957                | 89.07                  | 7,834,236.91        |

The net value of the recreation experience was \$3,120,000 for resident hunters and \$4,366,000 for resident fishermen or \$7,486,000 for all residents (Table 6). The net value of the recreation experience was \$349,000 for non-residents (\$315,000 for hunters and \$34,000 for fishermen).

<sup>1</sup>All figures are rounded to the nearest thousand.



Thus, the net value of the recreation experience for all resident and non-resident recreationists for the fiscal year ending March 31, 1969, was \$7,834,000.<sup>1</sup>

#### Society in General

The direct benefits that society in general received from the region's fish and wildlife resources for the fiscal year ending March 31, 1969, were \$519,000 in license fees and \$7,834,000 in extramarket benefits or \$8,353,000 in total (Table 7). The direct costs (i.e., the development,

Table 7

SOCIAL VALUE TO SOCIETY IN GENERAL FOR ALL HUNTING  
AND FISHING ACTIVITY IN SOUTHERN ALBERTA  
DURING THE FISCAL YEAR ENDING MARCH 31, 1969

| Item                                                                   | Number of<br>Licenses | Average Per<br>License | Totals       |
|------------------------------------------------------------------------|-----------------------|------------------------|--------------|
| License Fees                                                           |                       |                        |              |
| Resident hunters                                                       | 38,568                | \$ 9.23                | \$355,982.64 |
| Non-Resident hunters                                                   | 3,227                 | 12.68                  | 40,918.36    |
| Resident fishermen                                                     | 44,406                | 2.63                   | 116,787.78   |
| Non-Resident fishermen                                                 | 1,756                 | 3.17                   | 5,566.52     |
| Extramarket Benefits                                                   |                       |                        |              |
| Resident hunters                                                       | 38,568                | 80.90                  | 3,120,151.20 |
| Non-Resident hunters                                                   | 3,227                 | 97.47                  | 314,535.69   |
| Resident fishermen                                                     | 44,406                | 98.31                  | 4,365,553.86 |
| Non-Resident fishermen                                                 | 1,756                 | 19.36                  | 33,996.16    |
| Total Direct Benefits                                                  | 87,957                | 94.97                  | 8,353,492.21 |
| Costs for Development,<br>Management, and Operation<br>of the Resource |                       |                        |              |
|                                                                        | 87,957                | 4.52                   | 397,410.00   |
| ANNUAL NET SOCIAL VALUE                                                | 87,957                | 90.45                  | 7,956,082.21 |

<sup>1</sup>It should be remembered that the capitalized value would be considerably more than the annual value. For example, a resource that yields \$7,500,000 of annual net benefits in perpetuity at a discount rate of 8.0 percent has a capitalized value of \$93,750,000.



management, and operation costs of the Fish and Wildlife Division, Department of Lands and Forests) were \$1,198,230 for the entire province for the fiscal year ending March 31, 1969.<sup>1</sup> The above expenditures were allocated approximately evenly among six regions in Alberta. As the South Saskatchewan and Milk River Basins of Southern Alberta closely approximate the two regions of the Fish and Wildlife Division in Southern Alberta, one third of the total expenditures (\$397,410) can be attributed to the study area. Subtracting the above costs of \$397,410 from the total direct benefits gives \$7,956,000 as the annual net social value of Southern Alberta's sport fish and wildlife resources to society in general (Table 7).

#### Province of Alberta

The direct benefits used in determining the net social value of the region's sport fish and wildlife resources to the Province of Alberta are the same as those for society in general excepting non-resident extra-market benefits. The province is interested in non-resident extramarket benefits only in that they may indicate willingness to pay additional license fees. Using the same direct cost as above gives \$7,608,000 for net direct benefits (Table 8).

Non-resident expenditures (indirect benefits) have a multiplier effect on the final demand for the products of the industries concerned. All of the industries affected by expenditures of non-residents are classified as service industries. As the column totals of the Inverse Leontief matrix in the input-output table for the Province of Alberta indicate the total expansion in sales that will result in Alberta per dollar increase in final demand for the output of that industry, these column totals can

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<sup>1</sup> Gordon Kerr, Chief Wildlife Biologist, Fish and Wildlife Division, Department of Lands and Forests, Personal Letter, Edmonton, Alberta, March 20, 1970.



Table 8

SOCIAL VALUE TO THE PROVINCE OF ALBERTA FOR ALL  
HUNTING AND FISHING ACTIVITY IN SOUTHERN ALBERTA  
DURING THE FISCAL YEAR ENDING MARCH 31, 1969

| Item                                                               | Totals       |
|--------------------------------------------------------------------|--------------|
| License Fees                                                       |              |
| Resident hunters                                                   | \$355,982.64 |
| Non-Resident hunters                                               | 40,918.36    |
| Resident fishermen                                                 | 116,787.78   |
| Non-Resident fishermen                                             | 5,566.52     |
| Extramarket Benefits                                               |              |
| Resident hunters                                                   | 3,120,151.20 |
| Resident fishermen                                                 | 4,365,553.86 |
| Gross Direct Benefits                                              | 8,004,960.36 |
| Cost of Development, Management,<br>and Operation for the Resource | 397,410.00   |
| Net Direct Benefits                                                | 7,607,550.36 |
| Indirect Benefits Stemming from<br>Non-Resident Expenditures       |              |
| Hunters                                                            | 611,579.21   |
| Fishermen                                                          | 128,505.22   |
| Gross Indirect Benefits                                            | 740,084.43   |
| Indirect Costs Stemming from<br>Non-Resident Expenditures          |              |
| Hunters                                                            | 128,661.65   |
| Fishermen                                                          | 27,034.45    |
| Net Indirect Benefits                                              | 584,388.33   |
| ANNUAL NET SOCIAL VALUE TO ALBERTA                                 | 8,191,938.69 |

be considered as impact multipliers. The appropriate multiplier for service industries is 1.173370.<sup>1</sup> Non-resident hunters and fishermen spent

<sup>1</sup>R. W. Wright, The Alberta Economy--An Input-Output Analysis (Calgary: University of Alberta, 1964), p. 41. (Mimeographed.)



\$631,000 in Southern Alberta during the fiscal year ending March 31, 1969. Thus, the economic impact of this spending through the "multiplier effect" was \$740,000 (Table 8).

The accuracy of the above impact multiplier is limited for three reasons. First, the multiplier was computed for the entire province. It is difficult to estimate accurately the impact of non-resident expenditures on the region's economy without a regional input-output table. Because no such table has been constructed to date, it was assumed that the multiplier from the provincial input-output table would provide a reasonable approximation of the impact of non-resident expenditures on the economy of the region. A second limitation is that the data used in computing the impact multiplier is not current (i.e., 1962 data). A final limitation is that the multiplier for service industries was used even though recreation is only one component of the service industry.

The indirect costs associated with increased sales to non-residents are the extra expenditures on domestically produced inputs and imported inputs. These expenditures of 18.2332 cents for domestically produced inputs and 6.4517 cents for imported inputs constitute the 24.6849 cents in variable costs to the Alberta economy for supporting each additional dollar in sales to non-resident hunters and fishermen.<sup>1</sup> Therefore, the cost to the region's economy for supporting these sales was \$156,000 or 24.6849 percent of the total non-resident spending in Southern Alberta.<sup>2</sup>

The net social value of the sport fish and wildlife resources in the South Saskatchewan and Milk River Basins to the province was \$8,192,000

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<sup>1</sup>Ibid.

<sup>2</sup>It was assumed non-resident expenditures stemming from hunting and fishing activities were not sufficient to support additional capital expenditures (i.e., fixed costs).



for the fiscal year ending March 31, 1969, (Table 8). The service industries received \$584,000 of this total.

### Summary

The annual net benefits stemming from the hunting and fishing activities in Southern Alberta have been evaluated from three standpoints (Table 9). The net value of the recreation experience was \$89.07 per license sold. Comparable values to society in general and to the Province of Alberta were \$90.45 and \$93.22, respectively. These results indicate that the region's sport fish and wildlife resources are valuable both to the province and to the recreationists who pursue them.

The net value of the recreation experience (i.e., extramarket benefits) for all residents was nearly eight million dollars. Thus, a rough estimate of the non-priced component of the benefits received by residents far exceeds the net indirect effect of all non-resident expenditures (\$584,000) attributable to hunting and fishing activities in the region.

Table 9

BENEFITS AND COSTS FOR THE INDIVIDUAL RECREATION EXPERIENCE,  
SOCIETY IN GENERAL, AND THE PROVINCE OF ALBERTA  
FOR HUNTING AND FISHING ACTIVITY IN SOUTHERN ALBERTA  
DURING THE FISCAL YEAR ENDING MARCH 31, 1969

| Item                       | Individual Recreation<br>Experience | Society in<br>General | Province of<br>Alberta |
|----------------------------|-------------------------------------|-----------------------|------------------------|
| Direct Benefits            | \$12,424,665.87                     | \$8,353,492.21        | \$8,004,960.36         |
| Direct Costs               | 4,590,428.96                        | 397,410.00            | 397,410.00             |
| Indirect Benefits          | --                                  | --                    | 740,084.43             |
| Indirect Costs             | --                                  | --                    | 155,696.10             |
| TOTAL NET BENEFITS         | 7,834,236.91                        | 7,956,082.21          | 8,198,938.69           |
| NET BENEFIT<br>PER LICENSE | 89.08                               | 90.46                 | 93.22                  |



The Province of Alberta received a surplus of approximately eight million dollars in benefits over the cost of providing sport hunting and fishing activities (i.e., the net social value of the resource to the province). Society in general also received about eight million dollars in net social benefits. The policy implications of these benefits are discussed in the next chapter.



## CHAPTER V

### ECONOMIC SIGNIFICANCE OF ALTERNATIVE WATER RESOURCE

#### DEVELOPMENT PLANS: SUMMARY AND CONCLUSIONS

The primary purpose of this study was to determine the economic significance of alternative water resource development plans in relation to fish and wildlife resources in Southern Alberta. Objectives were outlined in the first chapter in view of this purpose. In reply to the first objective, the study region, consisting of the South Saskatchewan and Milk River Basins of Southern Alberta, and the sport fish and wildlife resources were described.

The second objective required an intensive investigation into the alternative water resource development plans proposed in the PRIME scheme. In general, if all the proposed projects were undertaken, the sport fishery would probably benefit the most through increased fish populations in many of the project areas. Waterfowl populations might also be increased, depending on which projects are carried out. However, any increases in fish and wildlife populations would depend almost entirely on how the projects were constructed and managed after completion. With upland game birds and big game the choice of alternative sites could play a particularly important role. Depending on which projects are undertaken, upland game bird populations may be increased. But big game populations would remain unchanged or decrease, depending on the choice of projects for development. Assuming all of the dams will not be constructed,



minimization of losses through selection of alternative sites that would have the fewest adverse effects on big game is the best that can be expected.

Considering the third objective, numerous values are derived annually from the region's sport fish and wildlife resources. The values derived from these resources for the individual recreation experience, society in general, and the Province of Alberta were approximately \$7.8 million, \$8.0 million, and \$8.2 million, respectively, for the fiscal year ending March 31, 1969. Other important values, although not investigated in this study, are also derived from the region's fish and wildlife resources.

In consideration of the fourth and final objective, the proposed water resource development projects, if undertaken, would likely affect fish and wildlife populations. These populations have notable value. There would, therefore, be a change in net social benefits unless the net social benefits from any increase in fish and/or wildlife populations exactly offset the net social loss from and decrease in fish and/or wildlife populations. Much depends on the choice of alternative sites. However, when choosing alternative sites, costs and benefits other than those affecting fish and wildlife certainly must be considered. Costs and benefits that cannot be quantified must be enumerated and given subjective consideration. When all factors except the effect of alternative sites on fish and wildlife are equal, sites should be chosen to minimize the losses and/or maximize the gains to fish and wildlife resources.<sup>1</sup>

At least four important policy implications stem from the above objectives and related research. First, in view of the valuable benefits derived annually from the region's fish and wildlife resources, policy

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<sup>1</sup>It should be remembered that outdoor recreation activities which do not stem from fish and wildlife must also be given consideration (i.e., water skiing, etc.).



makers and resource planners should give serious consideration to the needs of fish and wildlife before undertaking further resource development in Southern Alberta. Second, fish and wildlife biologists must participate in the planning, construction, and management stages of each project undertaken. If these two policy implications are not considered, it appears that fish and wildlife populations will probably be decreased by the PRIME scheme.<sup>1</sup> To the extent that the net social benefits to society from these resources are a direct function of fish and wildlife populations, such benefits would also decrease.

A third policy implication is that the large excess of benefits received from the resource over and above the costs of providing the same may justify greater expenditures on the resource. Although public expenditures may be warranted to improve the hunting and fishing opportunities presently available, public funds will probably be necessary first to maintain the present value of the fish and wildlife resources through prevention of irreversibilities that could result from further water resource development. Irreversibilities would reduce the value of the resources and create a flow of reduced social net benefits. Such a commitment of public funds is even more important because of probable increases in demand for hunting and fishing activities. Increased leisure time and population growth would probably account for most of this shift in demand.

A final policy implication is that private landowners should be compensated for providing habitat for wildlife from which they currently receive little or no benefit. Any benefit received by them may be partly

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<sup>1</sup>Two of the benefits outlined for the PRIME scheme are increased waterfowl and fish production. See: Alberta Department of Agriculture, Water Resources Division, Development Planning Branch, op. cit.



or completely offset by the costs associated with providing free public access to hunters (i.e., possible damage to livestock, etc.). In many instances private land is posted with "no trespassing" signs thus restricting hunting activity and the benefits derived thereof. Because most of the land in Southern Alberta is privately owned, it may be necessary to compensate these landowners with monetary incentives to insure the availability of the wildlife resource.

It is questionable whether or not society can afford to undertake water resource development with a single purpose criterion. Optimal resource allocation can only be accomplished when all agencies concerned are involved in the planning, construction, and management of any project. This study does not provide sufficient data for any agency to evaluate the economic significance in relation to fish and wildlife of any project under the PRIME scheme. It merely provides insights into the probable direction of change in populations of fish and wildlife and the overall importance of these populations to Alberta. Further research would be necessary for each of the reservoir sites before the ecological impact of its development could be accurately assessed. Only then would it be possible to determine the economic costs and benefits in relation to fish and wildlife for each proposed site.



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APPENDIX I

MISCELLANEOUS TABLES



Table I

## GEESE AND DUCKS OCCURRING IN SOUTHERN ALBERTA

| Geese                          |                                    |                               |
|--------------------------------|------------------------------------|-------------------------------|
| Species                        | Scientific Name                    | Occurrence <sup>a</sup>       |
| Western Canada Goose           | <i>Branta canadensis moffitti</i>  | Common Summer Resident        |
| Taverner's Canada Goose        | <i>Branta canadensis faverneri</i> | Common Migrant                |
| Lesser Canada Goose            | <i>Branta canadensis parvipes</i>  | Common Migrant                |
| Lesser Snow Goose              | <i>Chen hyperborea</i>             | Common Migrant                |
| White-Fronted Goose            | <i>Anser albifrons</i>             | Common Migrant                |
| Ross's Goose                   | <i>Chen rossi</i>                  | Fairly Common Migrant         |
| Ducks (Surface-Feeding)        |                                    |                               |
| Species                        | Scientific Name                    | Occurrence                    |
| Mallard (Common)               | <i>Anas platyrhynchos</i>          | Common Summer Resident        |
| Gadwall                        | <i>Anas strepera</i>               | Common Summer Resident        |
| Pintail                        | <i>Anas acuta</i>                  | Common Summer Resident        |
| Green-Winged Teal              | <i>Anas carolinensis</i>           | Fairly Common Summer Resident |
| American Widgeon<br>(Baldpate) | <i>Mareca americana</i>            | Common Summer Resident        |
| Shoveler                       | <i>Spatula clypeata</i>            | Common Summer Resident        |

<sup>a</sup>Occurrence refers to relative abundance within Southern Alberta.



Table I (continued)

| Ducks (Diving)                           |                                  |                                                       |
|------------------------------------------|----------------------------------|-------------------------------------------------------|
| Species                                  | Scientific Name                  | Occurrence                                            |
| Redhead                                  | <i>Aythya americana</i>          | Scarce Summer Resident                                |
| Ring-Necked Duck                         | <i>Aythya collaris</i>           | Fairly Common Migrant                                 |
| Canvasback                               | <i>Aythya valisineria</i>        | Scarce-Fairly Common Summer Resident                  |
| Lesser Scaup                             | <i>Aythya affinis</i>            | Fairly Common Summer Resident                         |
| Common Goldeneye<br>(American Goldeneye) | <i>Bucephala clangula</i>        | Common Migrant                                        |
| Barrow's Goldeneye                       | <i>Bucephala islandica</i>       | Fairly Common Summer Resident<br>(in Rocky Mountains) |
| Bufflehead                               | <i>Bucephala albeola</i>         | Fairly Common Migrant                                 |
| Oldsquaw                                 | <i>Clangula hyemalis</i>         | Fairly Common Migrant                                 |
| Harlequin Duck                           | <i>Histrionicus histrionicus</i> | Fairly Common Summer Resident<br>(in Rocky Mountains) |
| White-Winged Scoter                      | <i>Melanitta deglandi</i>        | Fairly Common Summer Resident                         |
| Ruddy Duck                               | <i>Lophocytes cucullates</i>     | Fairly Common Summer Resident                         |

Source: W. R. Salt and A. L. Wilk, Birds of Alberta (Edmonton: Alberta Department of Industry and Development, 1966).



TABLE II

CHARACTERISTICS OF RESIDENTS FISHING IN SOUTHERN ALBERTA  
FOR THE FISCAL YEAR ENDING MARCH 31, 1969

| Item             | Number<br>Responding<br>to Sample | Mean Days<br>Fished Per<br>Season | Mean<br>Expenditures<br>Per Day <sup>a</sup> | Mean<br>Travel Costs<br>Per Day <sup>b</sup> | Mean<br>Extramarket<br>Benefits<br>Per Day |
|------------------|-----------------------------------|-----------------------------------|----------------------------------------------|----------------------------------------------|--------------------------------------------|
| All<br>Residents | 712                               | 12.62                             | \$1.39                                       | \$1.97                                       | \$7.79                                     |

<sup>a</sup>Expenditures (exclusive of travel costs) were calculated as follows:

$$\text{Exp.} = \frac{\begin{array}{c} \text{Days} \\ \text{fished} \end{array} \times \begin{array}{c} \text{total} \\ \text{in region X expenditures} \end{array}}{\text{total days fished}}$$

<sup>b</sup>Travel costs were determined on the basis of five cents per mile for operating or variable costs. Mileage was calculated as follows:

$$\text{Mileage} = \frac{\begin{array}{c} \text{Trips} \\ \text{taken to} \end{array} \times \begin{array}{c} \text{round trip} \\ \text{mileage} \end{array}}{\begin{array}{c} \text{area} \\ \text{average number} \\ \text{in fishing party} \end{array} \times \text{to area}}$$



TABLE III

CHARACTERISTICS OF RESIDENTS HUNTING IN SOUTHERN ALBERTA  
FOR THE FISCAL YEAR ENDING MARCH 31, 1969

| Hunter Group       | Number Responding to Sample | Mean Days Hunted Per Season | Mean Expenditures Per Day <sup>a</sup> | Mean Travel Costs Per Day | Mean Extramarket Benefits Per Day |
|--------------------|-----------------------------|-----------------------------|----------------------------------------|---------------------------|-----------------------------------|
| Birds Only         | 402                         | 7.29                        | \$3.90                                 | \$2.01                    | \$ 8.75                           |
| Big Game Only      | 215                         | 7.51                        | 4.14                                   | 2.36                      | 10.95                             |
| Birds and Big Game | 286                         | 11.18                       | 4.22                                   | 2.06                      | 9.14                              |

<sup>a</sup>All expenditures exclusive of travel costs and rental equipment. Rentals were excluded because many hunters included expenditures that were obviously for travel in the space for rentals on the questionnaire. Expenditures and mileage were determined for hunters in a similar manner to resident fishing (Table II, previous page).



TABLE IV

CHARACTERISTICS OF NON-RESIDENTS FISHING IN SOUTHERN ALBERTA  
FOR THE FISCAL YEAR ENDING MARCH 31, 1969

| License Group         | Number Responding to Sample | Type Expenditure | Mean Days Fished Per Season | Mean Expenditure Per Season | Standard Deviation of Expenditures |
|-----------------------|-----------------------------|------------------|-----------------------------|-----------------------------|------------------------------------|
| Non-Resident Canadian | 3                           | I                | 8.67                        | \$132.33                    | \$151.02                           |
|                       | 16                          | II               | 5.19                        | 42.15                       | 40.19                              |
| Alien                 | 19                          | I                | 3.53                        | 73.37                       | 47.01                              |
|                       | 14                          | II               | 4.50                        | 80.57                       | 50.58                              |

## Note:

Expenditures of non-resident fishermen were calculated as follows:

$$\text{Type I Exp.} = \text{Total Exp. in Alberta} \times \frac{\text{Days Fished in Region}}{\text{Days Fished in Alberta}}$$

$$\text{Type II Exp.} = \text{Total Exp. in Alberta} \times \frac{\text{Days Fished in Region}}{\text{Days Spent in Alberta}} \\ \text{Less License and Guide Fees}$$

$$+ \text{License and Guide Fees} \times \frac{\text{Days Fished in Region}}{\text{Days Fished in Alberta}}$$

Fishermen that stated fishing was the primary purpose of their trip were classified under Type I expenditures. Type II expenditures were used for fishermen stating fishing was not the primary purpose of their trip.



TABLE V

CHARACTERISTICS OF NON-RESIDENTS HUNTING IN SOUTHERN ALBERTA  
FOR THE FISCAL YEAR ENDING MARCH 31, 1969

| License Group                  | Number Responding to Sample | Type Expenditure | Mean Days Hunted Per Season | Mean Expenditure Per Season | Standard Deviation of Expenditures |
|--------------------------------|-----------------------------|------------------|-----------------------------|-----------------------------|------------------------------------|
| Non-Resident Bird Game         | 68                          | I                | 5.78                        | \$155.89                    | \$107.45                           |
|                                | 13                          | II               | 4.15                        | 70.05                       | 37.35                              |
| Alien Bird Game                | 20                          | I                | 5.20                        | 208.47                      | 84.81                              |
|                                | 2                           | II               | 1.00                        | 44.88                       | 25.28                              |
| Non-Resident Big Game          | 3                           | I                | 10.67                       | 613.85                      | 98.91                              |
|                                | 0                           | II               | -                           | -                           | -                                  |
| Alien Big Game                 | 8                           | I                | 9.38                        | 746.74                      | 276.80                             |
|                                | 0                           | II               | -                           | -                           | -                                  |
| Non-Resident White-Tailed Deer | 2                           | I                | 6.50                        | 209.50                      | 36.66                              |
|                                | 1                           | II               | 5.00                        | 115.00                      | -                                  |
| Alien White-Tailed Deer        | 2                           | I                | 8.50                        | 517.48                      | 317.73                             |
|                                | 0                           | II               | -                           | -                           | -                                  |

Note:

Expenditures were calculated in the same manner as was done for non-resident fishing (Table IV, previous page).



TABLE VI

COMPARISON OF SAMPLE MEANS BETWEEN RESIDENTS VALUING AND  
RESIDENTS NOT VALUING EXTRAMARKET BENEFITS IN SOUTHERN ALBERTA  
FOR THE FISCAL YEAR ENDING MARCH 31, 1969

| Recreationist Group             | Percent of<br>Recreationists<br>Valuing Extra-<br>market Benefits | Statistic      | Mean for<br>Group Not<br>Valuing Extra-<br>market Benefits | Mean for<br>Group Valuing<br>Extramarket<br>Benefits | t-value <sup>a</sup> |
|---------------------------------|-------------------------------------------------------------------|----------------|------------------------------------------------------------|------------------------------------------------------|----------------------|
| Fishermen                       | 80.05                                                             | days fished    | 12.69                                                      | 12.62                                                | .0256                |
|                                 |                                                                   | expenditures   | \$1.24                                                     | \$1.39                                               | .6282                |
|                                 |                                                                   | miles traveled | 459.75                                                     | 496.64                                               | .3409                |
| Bird Hunters<br>Only            | 85.90                                                             | days hunted    | 6.25                                                       | 7.29                                                 | .4408                |
|                                 |                                                                   | expenditures   | \$3.70                                                     | \$3.90                                               | .0834                |
|                                 |                                                                   | miles traveled | 218.14                                                     | 292.85                                               | .6406                |
| Big Game<br>Hunters Only        | 82.38                                                             | days hunted    | 8.30                                                       | 7.51                                                 | .2928                |
|                                 |                                                                   | expenditures   | \$4.31                                                     | \$4.14                                               | .0985                |
|                                 |                                                                   | miles traveled | 335.77                                                     | 354.75                                               | .0978                |
| Bird and<br>Big Game<br>Hunters | 79.44                                                             | days hunted    | 10.92                                                      | 11.18                                                | .1062                |
|                                 |                                                                   | expenditures   | \$5.10                                                     | \$4.22                                               | .8434                |
|                                 |                                                                   | miles traveled | 456.49                                                     | 461.48                                               | .0424                |

<sup>a</sup>The test statistic used was as follows:  $ts = \frac{\bar{x} - \mu_H}{\hat{\sigma}/\sqrt{n}}$

where  $\bar{x}$ ,  $\hat{\sigma}$  and  $n$  are the mean, standard deviation, and sample size, respectively, for recreationists valuing extramarket benefits. The hypothesized population mean ( $\mu_H$ ) is the weighted average of the two sample means. For a 95 percent confidence level  $t$  must be  $\leq 1.645$ .



TABLE VII

COMPARISON OF STATISTICS BETWEEN THE MAIL SAMPLE  
AND THE FOLLOW-UP SAMPLE FOR RESIDENTS HUNTING IN SOUTHERN ALBERTA  
DURING THE FISCAL YEAR ENDING MARCH 31, 1969

| Hunter Group          | Number Respond-<br>ing to Follow-up<br>Sample <sup>a</sup> | Number Respond-<br>ing to Mail<br>Sample | Statistic            | Mean for<br>Follow-up<br>Sample | Mean for<br>Mail<br>Sample | t-value <sup>b</sup> |
|-----------------------|------------------------------------------------------------|------------------------------------------|----------------------|---------------------------------|----------------------------|----------------------|
| Birds Only            | 27                                                         | 402                                      | days hunted          | 5.44                            | 7.29                       | .2779                |
|                       |                                                            |                                          | expenses             | \$3.67                          | \$3.90                     | .0329                |
|                       |                                                            |                                          | miles traveled       | 339.64                          | 292.85                     | .1340                |
|                       |                                                            |                                          | extramarket benefits | \$12.33                         | \$8.75                     | .3104                |
| Big Game<br>Only      | 17                                                         | 215                                      | days hunted          | 6.94                            | 7.51                       | .0822                |
|                       |                                                            |                                          | expenses             | \$4.59                          | \$4.14                     | .0923                |
|                       |                                                            |                                          | miles traveled       | 383.69                          | 354.75                     | .0567                |
|                       |                                                            |                                          | extramarket benefits | \$10.29                         | \$10.95                    | .0592                |
| Birds and<br>Big Game | 23                                                         | 286                                      | days hunted          | 9.65                            | 11.18                      | .1752                |
|                       |                                                            |                                          | expenses             | \$4.00                          | \$4.22                     | .0605                |
|                       |                                                            |                                          | miles traveled       | 393.26                          | 461.43                     | .1613                |
|                       |                                                            |                                          | extramarket benefits | \$13.90                         | \$9.14                     | .5354                |

<sup>a</sup>Number responding to sample refers only to respondents who valued extramarket benefits.

<sup>b</sup>The test statistic used was as follows:

$$t_s = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{N_1 S_1^2 + N_2 S_2^2}{N_1 + N_2 - 2}}}$$

where  $\bar{X}$ ,  $N$  and  $S^2$  refer to the mean, sample size and variance, respectively. For a 95 percent level of confidence,  $t_s$  must be  $\leq 1.645$ .



APPENDIX II

HUNTING AND FISHING

QUESTIONNAIRES



## RESIDENT HUNTING INFORMATION - 1968 HUNTING SEASON

A. Travel Information

1. Residence \_\_\_\_\_  
(city or town)
2. What method(s) of transportation did you use traveling to the hunting area(s)? \_\_\_\_\_

B. Hunting Information

1. What Alberta licences did you hold last year? (check please)  
 Bird Game\_\_\_\_, Mule Deer\_\_\_\_, Whitetail Deer\_\_\_\_, Moose\_\_\_\_,  
 Moose (Zone 1)\_\_\_\_, Elk\_\_\_\_, Sheep\_\_\_\_, Goat\_\_\_\_, Caribou\_\_\_\_,  
 Grizzly Bear\_\_\_\_, Angling licence\_\_\_\_,  
 Others \_\_\_\_\_ (please specify)
2. Please answer the following:

| Areas Hunted:<br>Please List<br>Nearest Town<br>or Landmark | Days<br>Hunted<br>in Area | Trips<br>Taken<br>to Area | Miles<br>to Area | Number<br>in<br>Hunting<br>Party | Game You<br>Hunted in<br>Each Area | Game Bagged<br>by You<br>Type and<br>Number |
|-------------------------------------------------------------|---------------------------|---------------------------|------------------|----------------------------------|------------------------------------|---------------------------------------------|
| (example)<br>Vermilion                                      | 3                         | 3                         | 120              | 2                                | ducks and<br>geese                 | 15 ducks<br>2 geese                         |
| 1.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 2.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 3.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 4.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 5.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 6.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 7.                                                          |                           |                           |                  |                                  |                                    |                                             |
| 8.                                                          |                           |                           |                  |                                  |                                    |                                             |

3. How would you evaluate your hunting trip(s) in Alberta last year?  
 Check One  
 Excellent\_\_\_\_, Very Good\_\_\_\_, Good\_\_\_\_, Fair\_\_\_\_, Poor\_\_\_\_.
4. How much did you personally spend on the following in Alberta  
 during the 1968 hunting season?
  - (a) vehicle and equipment rentals \$\_\_\_\_\_
  - (b) guides, horses, and other hunting services \$\_\_\_\_\_
  - (c) lodging (motels, hotels, etc.) \$\_\_\_\_\_
  - (d) ammunition \$\_\_\_\_\_



C. General Information

This information will help us estimate the demand for hunting wildlife in Alberta.

1. What is your age? \_\_\_\_\_
2. What is your occupation? \_\_\_\_\_
3. Approximately how much is your gross family income  
(per year)? \$ \_\_\_\_\_
4. How many years of formal education do you have? \_\_\_\_\_

D. Evaluation

This question is asked to help us determine the value of our wildlife resources to hunters.

1. Approximately how much do you think a day's hunting is worth  
(above what you spend on travel and other expenses):
  - (a) Big game hunting? Do not hunt big game \_\_\_\_\_  
\$0\_\_\_\_, \$1\_\_\_\_, \$2\_\_\_\_, \$3\_\_\_\_, \$4\_\_\_\_, \$5\_\_\_\_, \$10\_\_\_\_, \$15\_\_\_\_,  
other \$\_\_\_\_.
  - (b) Bird hunting? Do not hunt birds \_\_\_\_\_  
\$0\_\_\_\_, \$1\_\_\_\_, \$2\_\_\_\_, \$3\_\_\_\_, \$4\_\_\_\_, \$5\_\_\_\_, \$10\_\_\_\_, \$15\_\_\_\_,  
other \$\_\_\_\_.
2. Have you any additional remarks that may help us evaluate the  
hunting in Alberta?

\_\_\_\_\_  
\_\_\_\_\_  
(please use back if necessary)



## NON-RESIDENT HUNTING INFORMATION - 1968 HUNTING SEASON

A. Travel Information

1. Residence \_\_\_\_\_  
(city or town) (state or province)
2. What method(s) of transportation did you use traveling to the hunting area(s)?  
\_\_\_\_\_
3. What Alberta licences did you hold last year? (please check)  
Bird Game\_\_\_\_, Big Game\_\_\_\_, Special Moose\_\_\_\_, Whitetailed Deer\_\_\_\_,  
Spring Bear\_\_\_\_, Angling licence\_\_\_\_.

B. Hunting Information

1. Please complete the following:

| Trips to Alberta | Number in Hunting Party | Days Spent in Alberta | Areas Hunted: Please List Nearest Town or Landmark                   | Days Hunted in Area | Game You Hunted in Each Area | Game Bagged By You (Type and Number) |
|------------------|-------------------------|-----------------------|----------------------------------------------------------------------|---------------------|------------------------------|--------------------------------------|
| 1st Trip         |                         |                       | 1. _____<br>2. _____<br>3. _____<br>4. _____<br>5. _____<br>6. _____ |                     |                              |                                      |
| 2nd Trip         |                         |                       | 1. _____<br>2. _____<br>3. _____<br>4. _____<br>5. _____<br>6. _____ |                     |                              |                                      |
| 3rd Trip         |                         |                       | 1. _____<br>2. _____<br>3. _____<br>4. _____<br>5. _____<br>6. _____ |                     |                              |                                      |

2. Was 1968 the first year you hunted in Alberta? Yes\_\_\_\_ No\_\_\_\_
3. Do you plan to hunt again in Alberta? Yes\_\_\_\_ No\_\_\_\_
4. How would you evaluate your game hunting in Alberta? (check one)  
Excellent\_\_\_\_, Very Good\_\_\_\_, Good\_\_\_\_, Fair\_\_\_\_, Poor\_\_\_\_.
5. Was hunting the main purpose of your trip? Yes\_\_\_\_ No\_\_\_\_  
If no, what was the main purpose? \_\_\_\_\_



C. Expenditure Information

1. How much did you personally spend on your hunting trip(s) to Alberta? (please indicate total trip expenditure for all trips)

(a) travel (include plane, all vehicle, rentals, etc.) \$ \_\_\_\_\_

(b) food and lodging (include all motel, hotel, food beverages, etc.) \$ \_\_\_\_\_

(c) fees (include licences, guiding, etc.) \$ \_\_\_\_\_

(d) misc. (include all supplies purchased on trip, ammunition, etc.) \$ \_\_\_\_\_

2. Approximately how much of the above was spent in Alberta?

(a) travel \$ \_\_\_\_\_

(b) food and lodging \$ \_\_\_\_\_

(c) fees \$ \_\_\_\_\_

(d) misc. \$ \_\_\_\_\_

D. General Information

This information will help us estimate the demand for hunting wildlife in Alberta.

1. What is your age? \_\_\_\_\_

2. What is your occupation? \_\_\_\_\_

3. Approximately how much is your gross family income (per year)? \$ \_\_\_\_\_

4. How many years of formal education do you have? \_\_\_\_\_

E. Evaluation

This question is asked to help us determine the value of our wildlife resources to hunters.

1. Approximately how much do you think a day's hunting is worth (above what you spend on travel and other costs)?

(a) big game hunting? (check one) Do not hunt big game \_\_\_\_\_  
\$0\_\_, \$1\_\_, \$2\_\_, \$3\_\_, \$4\_\_, \$5\_\_, \$10\_\_, \$15\_\_, other \$\_\_\_\_

(b) bird hunting? (check one) Do not hunt birds \_\_\_\_\_  
\$0\_\_, \$1\_\_, \$2\_\_, \$3\_\_, \$4\_\_, \$5\_\_, \$10\_\_, \$15\_\_, other \$\_\_\_\_

2. Have you any additional remarks that may help us evaluate the hunting in Alberta?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



## RESIDENT FISHING INFORMATION

1968-69 FISHING SEASON

A. Travel Information

1. Residence \_\_\_\_\_  
(city or town)
2. What method(s) do you usually use:
  - (a) travelling to the fishing area(s)? \_\_\_\_\_
  - (b) at the fishing area(s)? (check one) \_\_\_\_\_  
private boat\_\_\_\_, rented boat\_\_\_\_, did not use boat\_\_\_\_
  - (c) did you also hold an Alberta hunting licence? Yes\_\_ No\_\_
3. If you used a boat, please state number of days. \_\_\_\_\_

B. Fishing Information

1. Please answer the following:

| Areas fished:<br>please list<br>nearest town<br>or landmark | Days<br>fished<br>in<br>area | Trips<br>taken<br>to<br>area | Number<br>in<br>fishing<br>party | Miles<br>to<br>area | What were<br><u>you</u> fishing<br>for? | Approximate<br>number <u>you</u><br>caught |
|-------------------------------------------------------------|------------------------------|------------------------------|----------------------------------|---------------------|-----------------------------------------|--------------------------------------------|
| (example)<br>Cold Lake                                      | 2                            | 2                            | 2                                | 180                 | trout                                   | 20                                         |
| 1.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 2.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 3.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 4.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 5.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 6.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 7.                                                          |                              |                              |                                  |                     |                                         |                                            |
| 8.                                                          |                              |                              |                                  |                     |                                         |                                            |

2. How would you evaluate your fishing trip(s) in Alberta?  
(check one)  
Excellent\_\_\_\_, Very good\_\_\_\_, Good\_\_\_\_, Fair\_\_\_\_, Poor\_\_\_\_
3. How much did you personally spend for fishing on the following  
in Alberta, during the 1968 fishing season?
  - (a) guides, horses, and other fishing services \$ \_\_\_\_\_
  - (b) lodging (hotels, motels, etc.) \$ \_\_\_\_\_
  - (c) rentals (boat, equipment, etc.) \$ \_\_\_\_\_



4. What is the approximate total value of your present fishing equipment including fishing tackle, gear, etc.? (do not include boat or trailer) \$ \_\_\_\_\_
5. Approximately how much do you spend each year replacing, repairing or adding to your fishing equipment? \$ \_\_\_\_\_
6. Did you ice fish during the 1968-69 fishing season?  
                     Yes \_\_\_\_\_ No \_\_\_\_\_  
     If yes, approximately how many days? \_\_\_\_\_

C. General Information

This information will help us estimate the demand for fishing in Alberta.

1. What is your age? \_\_\_\_\_
2. What is your occupation? \_\_\_\_\_
3. Approximately how much is your gross family income (per year)?  
                                     \$ \_\_\_\_\_
4. How many years of formal education do you have? \_\_\_\_\_

D. Evaluation

This question is asked to help us determine the value of our fishing resources to the fishermen.

1. Approximately how much do you think a day's fishing is worth (above what you spend on travel and other expenses)?  
     \$0\_\_, \$1\_\_, \$2\_\_, \$3\_\_, \$4\_\_, \$5\_\_, \$10\_\_, \$15\_\_, other \$\_\_
2. Have you any additional remarks that may help us evaluate our fishing resources?

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## NON-RESIDENT FISHING INFORMATION - 1968-69 FISHING SEASON

A. Travel Information

1. Residence \_\_\_\_\_  
(city or town) (state or province)
2. What method(s) of transportation did you use:
  - (a) travelling to the fishing area(s)? \_\_\_\_\_
  - (b) at the fishing area(s)? (check one)  
private boat\_\_\_\_, rented boat\_\_\_\_, did not use boat\_\_\_\_
  - (c) if you used a boat, please state number of days \_\_\_\_\_
  - (d) did you also hold an Alberta hunting licence? Yes\_\_ No\_\_

B. Fishing Information

1. Please complete the following:

| Trips<br>to<br>Alberta | Number<br>in<br>fishing<br>party | Days<br>spent<br>in<br>Alberta | Areas fished:<br>please list<br>nearest town<br>or landmark | Days<br>fished<br>in<br>area | What were<br>you fishing<br>for? | Approximate<br>number<br>you<br>caught |
|------------------------|----------------------------------|--------------------------------|-------------------------------------------------------------|------------------------------|----------------------------------|----------------------------------------|
| 1st<br>Trip            |                                  |                                | 1.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 2.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 3.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 4.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 5.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 6.                                                          |                              |                                  |                                        |
| 2nd<br>Trip            |                                  |                                | 1.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 2.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 3.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 4.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 5.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 6.                                                          |                              |                                  |                                        |
| 3rd<br>Trip            |                                  |                                | 1.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 2.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 3.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 4.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 5.                                                          |                              |                                  |                                        |
|                        |                                  |                                | 6.                                                          |                              |                                  |                                        |

2. Was fishing the primary purpose of your trip(s)? Yes\_\_ No\_\_
3. If fishing was not the primary purpose of your trip(s), what was?  
\_\_\_\_\_
4. How would you evaluate your fishing trip(s) in Alberta last year?  
(check one) Excellent\_\_\_\_, Very Good\_\_\_\_, Good\_\_\_\_, Fair\_\_\_\_, Poor\_\_



5. Was this the first year you fished in Alberta? Yes\_\_\_ No\_\_\_

6. Do you plan to fish again in Alberta? Yes\_\_\_ No\_\_\_

C. Expenditures Information

1. How much did you personally spend on your fishing trip(s) to Alberta? (please indicate total trip expenditures for all trips)

(a) travel (include plane, all vehicle,  
rentals, etc.) \$ \_\_\_\_\_

(b) food and lodging (include all food, motel,  
beverages, etc.) \$ \_\_\_\_\_

(c) fees (include licence, guiding, etc.) \$ \_\_\_\_\_

(d) misc. (include all supplies purchased on trip) \$ \_\_\_\_\_

2. How much of the above was spent in Alberta?

(a) travel \$ \_\_\_\_\_

(b) food and lodging \$ \_\_\_\_\_

(c) fees \$ \_\_\_\_\_

(d) misc. \$ \_\_\_\_\_

D. General Information

This information will help us estimate the demand for fishing in Alberta.

1. What is your age? \_\_\_\_\_

2. What is your occupation? \_\_\_\_\_

3. Approximately how much is your gross family income  
(per year)? \$ \_\_\_\_\_

4. How many years of formal education do you have? \_\_\_\_\_

E. Evaluation

This question is asked to help us determine the value of our fishing resources to fishermen.

1. Approximately how much do you think a day's fishing is worth  
(above what you spend on travel and other expenses)? (check one)  
\$0\_\_\_, \$1\_\_\_, \$2\_\_\_, \$3\_\_\_, \$4\_\_\_, \$5\_\_\_, \$10\_\_\_, \$15\_\_\_, other \$\_\_\_

2. Have you any additional remarks that may help us evaluate our fishing resources?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_





JUN 6 1975



